APPENDIX A

ST. JOHN REPORT

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

A PRELIMINARY HYDROGEOLOGIC INVESTIGATION IN THE NORTHERN PORTION OF DEAD CREEK AND VICINITY

By

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Introduction

Problem

The Illinois Environmental Protection Agency (IEPA) was made aware of a site in Cahokia, Illinois in May, 1980. There was a problem with periodic smoldering of materials in a ditch (Dead Creek) due to random dumping. Immediately, the problem did not appear to be serious, but when a local resident's dog rolled in the ditch and died of apparent chemical burns in August, 1980, it was clear that further investigation was need. IEPA personnel then did preliminary soil and water sampling to determine the conditions in the ditch. Upon finding that the soil in the ditch contained high levels of phosphorus, heavy metals, and PCB's, the Agency sealed the site off. This was done by the Illinois Department of Transportation (IDOT) and involved the installation of 7,000 feet of snow fence around the ditch and pond between Queeny Avenue and Judith Lane. It appeared to the Agency that soils and ground water were polluted in the area, and a detailed study was needed to assess the extent of pollution.

Purpose

The purpose of this study is to determine the hydrogeological framework at Dead Creek and to discuss possible disposal sites and their impact on ground water, surface water, soils, and plants in the area.

Method of Study

The study was primarily conducted by the Ground Water Management Section of the Division of Land/Noise Pollution Control, IEPA. Preliminary study involved the review of data in files, field work, and laboratory analysis. Adjacent land owners and businesses were contacted and permission was obtained for IEPA personnel and equipment to enter on their properties. Information was obtained from the Illinois State Geological Survey (ISGS) and the Illinois State Water Survey (ISWS) as to the general geology, and ground water conditions in the area. Local residents and officials were interviewed and a series of past aerial photographs were obtained to determine the site's history.

On September 8, 1980, the Agency's drill-rig sub-unit began to work at the site. This work included five hand auger borings, and the drilling of 12 test holes to determine the local geology and to install ground water monitoring wells. Soil samples were collected to analyze their physical and chemical properties. The ground water from the wells was sampled for quality and the potentiometric levels were recorded from time to time.

All inorganic soil and water analyses from the site was done by the IEPA Champaign Laboratory using the Inductively Coupled Argon Plasma (ICAP) emission spectrometric method. Organic soil and water analyses were done at the IEPA Springfield Laboratory using gas chromotography/mass spectometry methods. Grain size and permeability analyses for the soils, were also performed by the IEPA Champaign Laboratory according to ASTM standards.

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Other

At the EPA, Region V, the Environmental Monitoring Systems Laboratory
conduc rared survey of the subject site and its vicinity (Becker,
1981). Scanner Data and color infrared photographs were obtained
in Dec analyzed. Five active waste disposal areas and two probable,
revege s were identified from the color infrared photography
(Figur re, four outfalls were detected entering the holding
ponds Company's property. These were detected from the Multispectral
Scanne

Acknow

Thanks the Emergency Action Center of the IEPA, ISGS, ISWS,
IDOT, of Engineers (USACE), U. S. Department of Agriculture
(USDA) mpany, Mr. Reed Neuman of the Attorney General's Office,
and Ho Inc. for materials, assistance, and services. A special
thanks r. Paul Hiegold of the ISGS for his assistance on field
studie f field data was collected by Doug Tolan and Ken Bosie.

Site Description

Locati

Dead C n the towns of Sauget and Cahokia in St. Clair County,
Illino . The creek supplies drainage for part of the Mississippi
River as the American Bottoms. It starts in the town of Sauget
and fl ough Cahokia until it discharges into the Prairie DuPont
Floodw in turn discharges to the Cahokia Chute of the Mississippi
River.

As mig a flood plain, the area is typified by very little relief,
and is t flooding by a system of levees that front the river.

The ar s report is outline in the square on Figure 1. Although
some o llected outside, the study area is the part of Dead Creek
bounded e and Judith Lane.

Climate

The sit the northern temperate zone which is characterized by
warm su tely cold winters. The average annual precipitation
in the inches (ISWS, 1965). Figure 2a shows the mean monthly
average dsville. The greatest amounts of rainfall occur from
March t n a gradual monthly decline occurs until December. With
the ave evapotranspiration given to be about 33 inches (Figure
2b), th ial water surplus is then about 5 inches for the area
in a ye s surplus water will infiltrate the soil and move downward.

Site Development

Subsequ data in files and interviewing several persons, it was
conclud ion problem might exist outside the realm of mere dumping
into th Local residents reported a wide variety of past waste
disposa the area. All had two main themes: 1) that gravel pits
had exi on the east side of the creek near Sauget Town Hall
and 2) f waste had been buried in the pits prior to their filling.

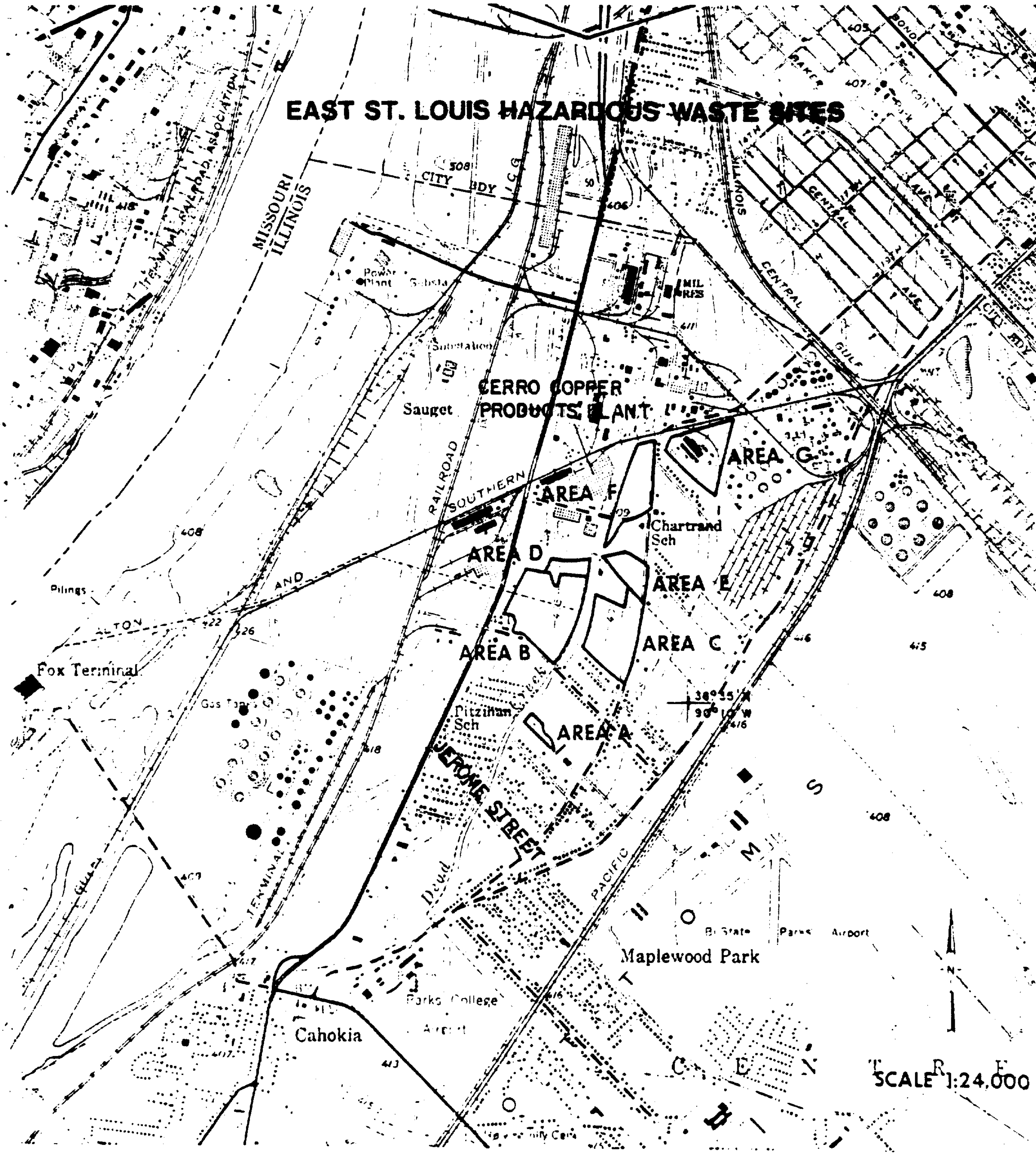


Figure 1a. Waste sites identified by the thermal infrared survey.

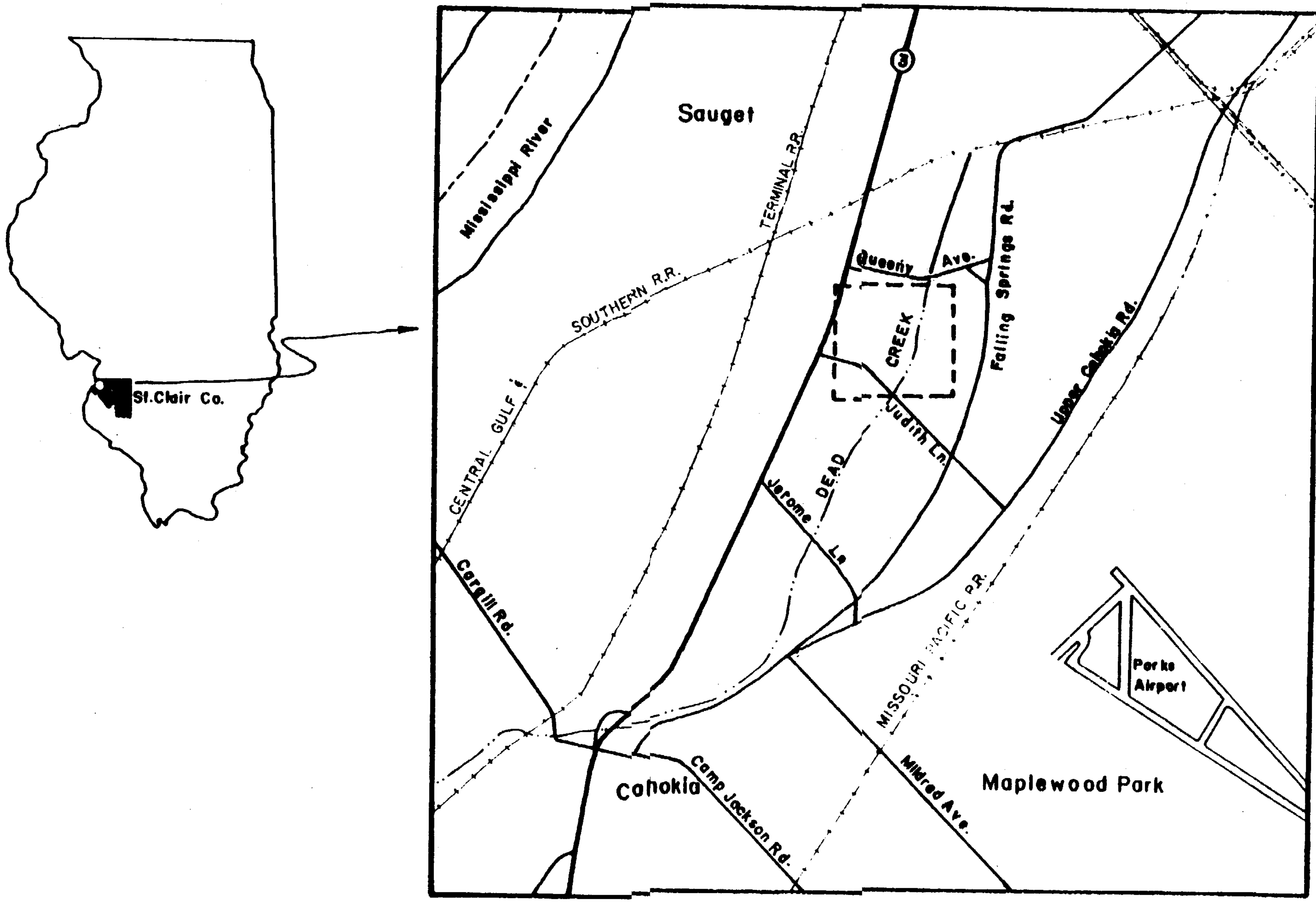
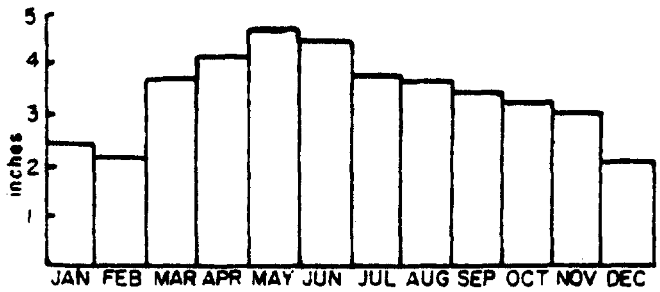
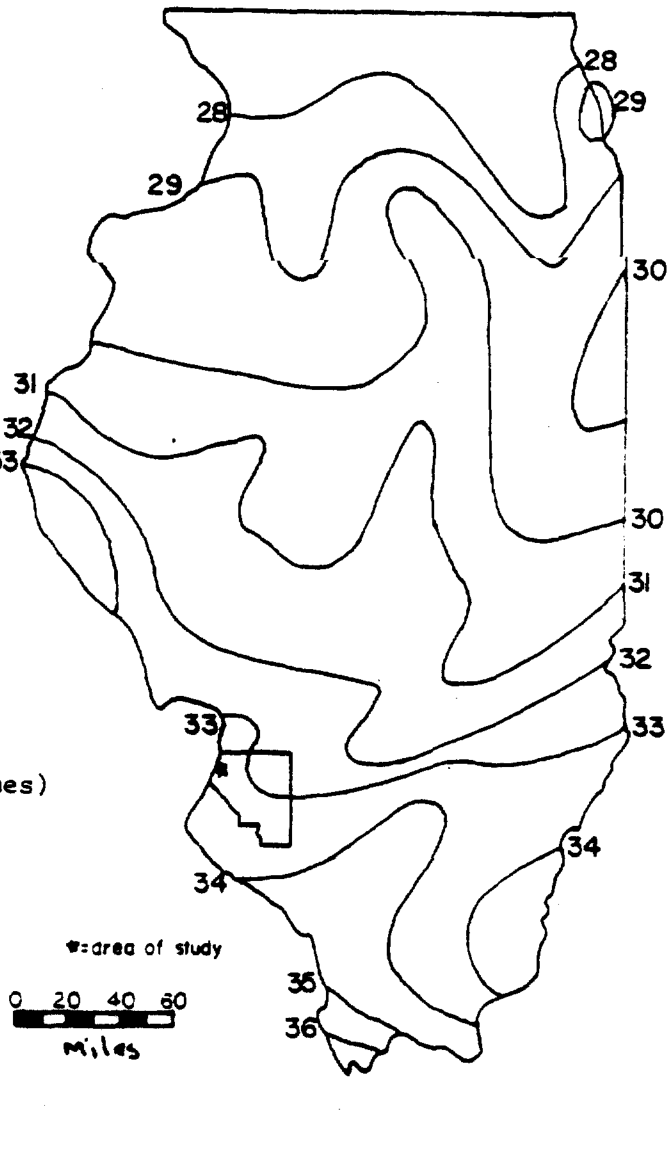


Figure 1. Location of Dead Creek and study site (square)



(a) Mean monthly precipitation at Edwardsville, Illinois (1932-1962



(b) Mean annual calculated evapotranspiration (in inches) over 45 years (Jones, 1966)

Figure 2. Climatological data

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To confirm the information on these past events, a series of aerial photographs for stereo viewing was ordered for the years 1937, 1940, 1950, 1955, and 1962. From the analyses of aerial photographs and review of the file data, the following potential disposal sites were identified: an open dump, part of which was a sand pit, a holding pond at Cerro Copper, a disposal impoundment, a pond by H. H. Hall Construction Company (a former sand pit), and 3 sand pits which are now filled. Two probable disposal areas on each side of Dead Creek, identified by Becker (1981) were not supported by the aerial photographs.

1937

Figure 3a is a drawing made from aerial photographs of the area in 1937. The Figure shows a large sand pit (A) on the east side of Dead Creek with an access road leading up to Old Queeny Avenue.

1940

Figure 3b is a drawing which represents the area in 1940. The sand pit (A) has been enlarged towards the east and the access road now leads to Falling Springs Road.

1950

The next photographs were taken in 1950, a drawing of these photos is shown on Figure 3c. It is evident from the phtographs that a great deal of change took place in ten years. The former large pit (A) has now been bisected by a berm with New Queeny Avenue built on top of it. The pit was partially filled in the eastern half, south of New Queeny Avenue, and enlarged a great deal to the north. Aside from this, four new pits were excavated. Two are north (B) and south (C) of Old Queeny Avenue along Dead Creek. One (D) is on the west side of the creek just south of New Queeny Avenue. The last is a large pit (E) dug by H. H. Hall Construction Company near Judith Lane whose access road probably became Walnut Street. In this photograph the south branch of Old Queeny Avenue has been subtended and Sauget Town Hall is under construction where the street once was.

This verifies the statements by local residents that sand pits were once located around Sauget Town Hall.

1955

The drawing (Figure 3d) from photographs taken during 1955 again show a drastic change. Sauget Town Hall is completed and is surrounded by low lying areas. These low lying areas are the result of fill materials settling in the former sand pits. At this time, the pit (B) on the east side of the creek across from Cerro Copper has yet to be completely filled. The pit (E) by Judith Lane is still unchanged.

1962

By 1962 (Figure 3e), the drawing shows that the pits once surrounding Sauget Town Hall have been filled. Settlement has developed prominent troughs in areas that were previously excavations. The only remaining pit is still the one south by Judith Lane (E).

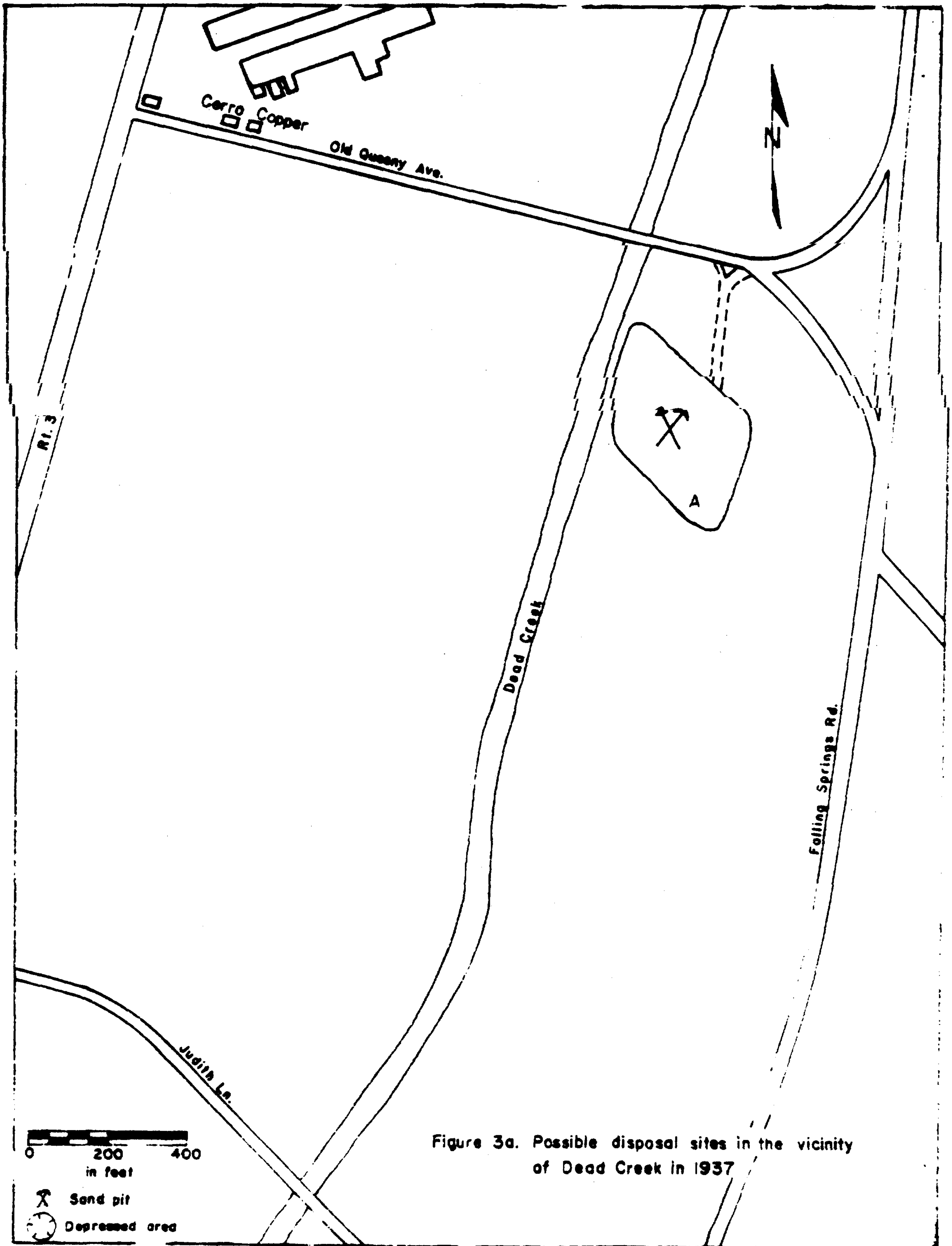

Figure 3a. Possible disposal sites in the vicinity of Dead Creek in 1937

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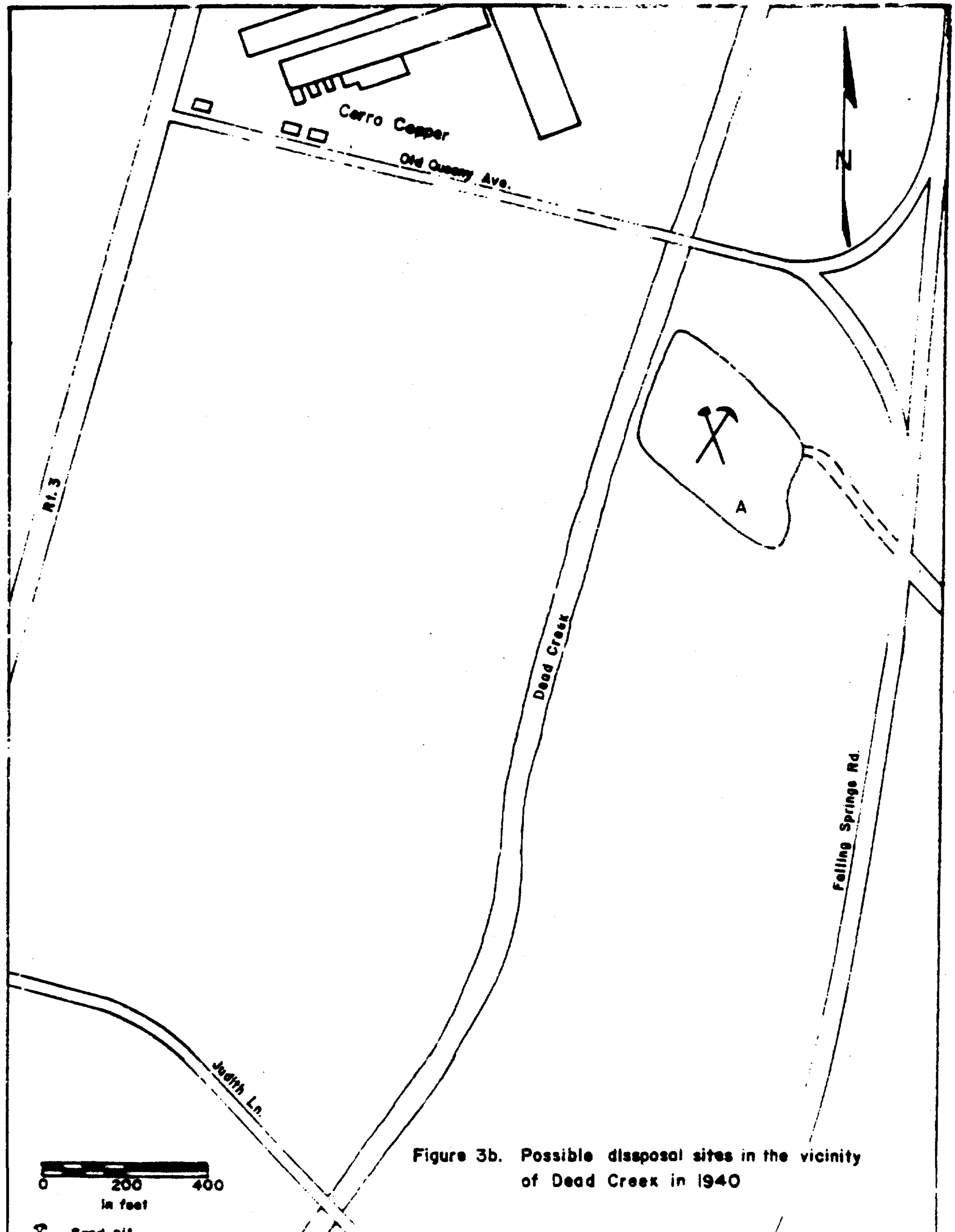

Figure 3b. Possible disposal sites in the vicinity of Dead Creek in 1940

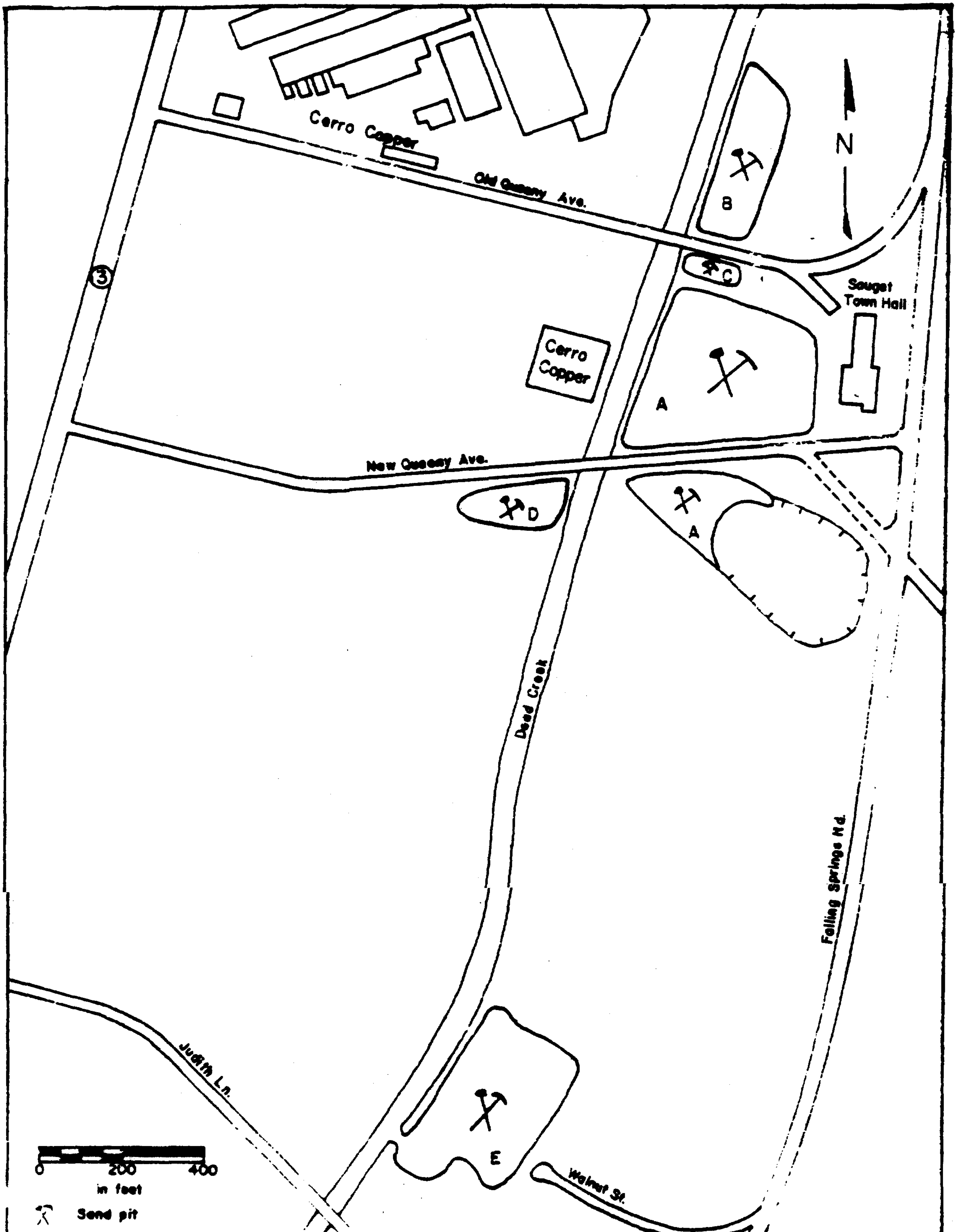

Figure 3c. Possible disposal sites in the vicinity of Dead Creek in 1950

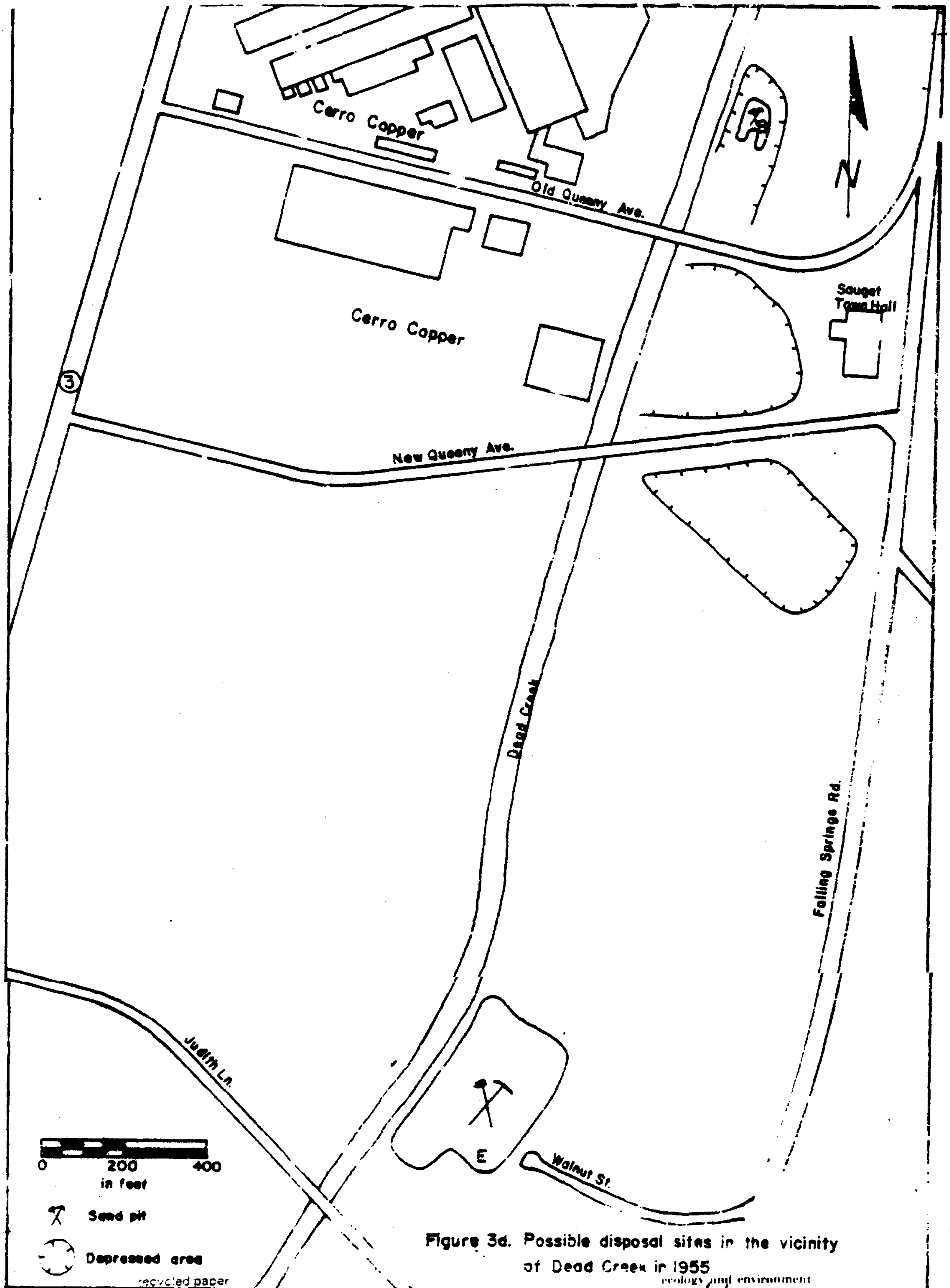

Figure 3d. Possible disposal sites in the vicinity of Dead Creek in 1955

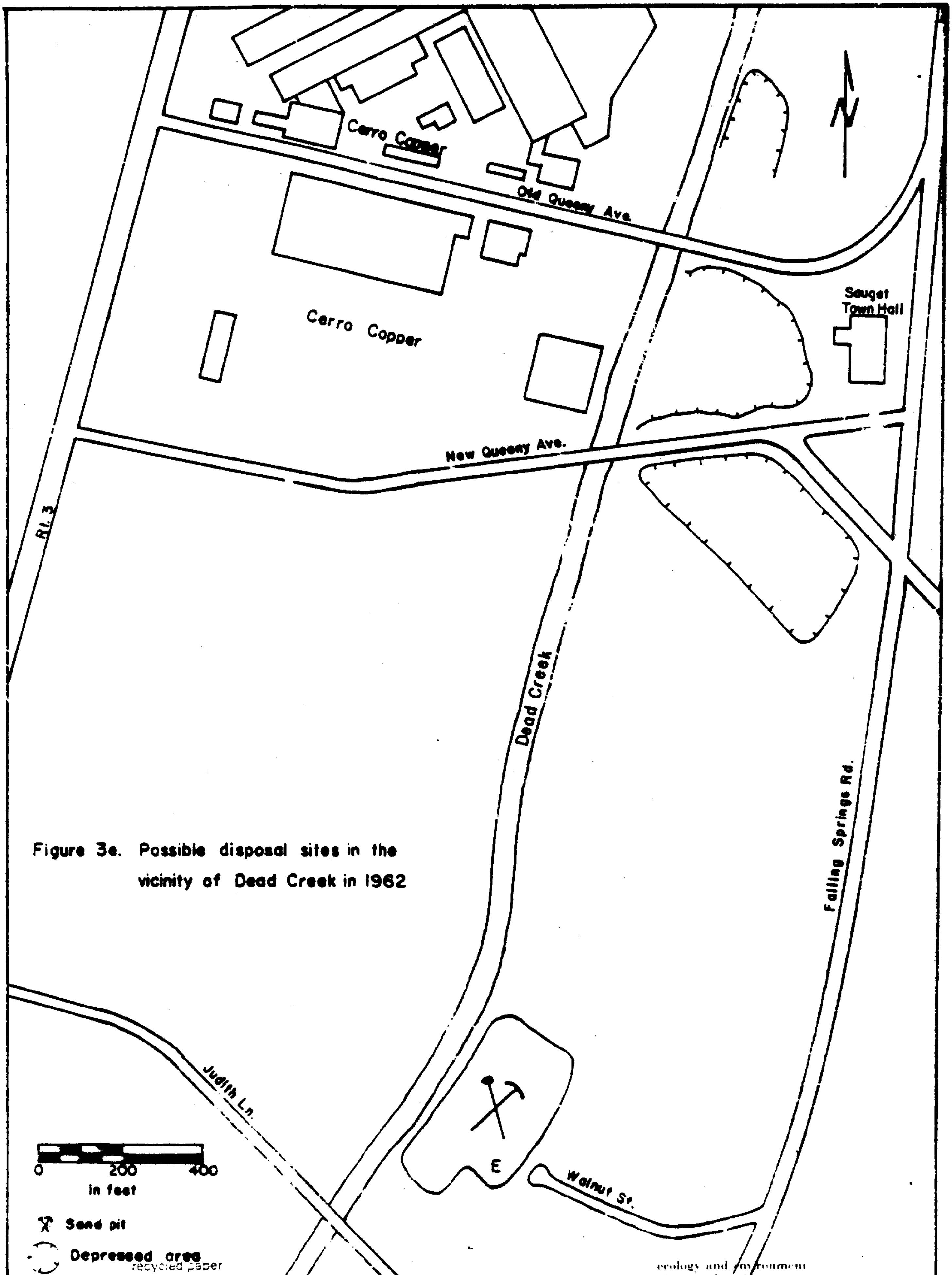

Figure 3e. Possible disposal sites in the vicinity of Dead Creek in 1962

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1973

Figure 3f was drawn from a map of the East St. Louis area developed by the USACE. It shows the location of Harold Waggoner and Company, a trucking firm which specialized in hauling industrial wastes.

Mr. Waggoner operated the company from 1964 to 1974 when he sold out to Ruan Trucking Company. Prior to August 6, 1971, Mr. Waggoner made a practice of washing his waste hauling trucks out and discharging the contents into Dead Creek (IEPA files). At this time, he was ordered by the IEPA to stop such practices and inform the Agency of his plans for future operation. This is when the disposal impoundment pictured in Figure 3f was put into use. Disposal into this impoundment only served to turn surface water pollution into ground water pollution. Ruan Trucking Company is said to have continued this practice until 1978 when they leased the property to Metro Construction Company who subsequently covered it up. (Personal communication, Attorney General's Office).

Other possible sources of pollution at the creek

At the time of writing, the only other known source of discharge into the creek was that by Midwest Rubber Company. From the late 1940's to the early 1960's they had a pipeline leading from their factory on Illinois Route 3 to the creek. It discharged wastes from their manufacturing process, which included rubber, into the creek. These wastes most likely account for the "bed spring" effect when one walks in the creek bottom.

Field Work

Aerial photographs of the site would not arrive until the drilling phase of the investigation was completed. It was felt, then, that geophysical methods might be employed to determine the location, size, and depth of the pits, and whether they contained drums. It was obvious while at the site that portions of it had slightly subsided. These sunken areas were felt to be where former pits could have been (later proven correct by the aerial photos). If drums had been buried in them it was reasonable that a metal detector survey might determine these locations. This proved to be fruitless as the fill, and the area in general, consisted mostly of demolition wastes containing large amounts of metal. Since electrical resistivity is affected by metal, it was rendered useless as well. A seismic survey run by the ISGS was the only other means of obtaining information about the pits. Unfortunately, the data from the seismic profile was inconclusive due to interference (noise) by local industry and traffic. Thus, none of the geophysical methods employed was useful. Specifications of geophysical instruments are in Appendix 3.

Following the geophysical investigation, five had auger borings and 12 test holes were drilled. The 12 test holes were later implaced with ground water monitoring wells. The location of these monitoring wells, along with the hand auger borings, and local topography are shown on Figure 4.

Appendix 1 is boring log and monitor well information and Appendix 2 contains selected grain size distribution and permeability data from these borings. The class limits scale used was a modified Wentworth-Lane (Pettijohn, 1975) and the textural terminology was that used in Figure A-1. The monitor well depth ranged from 28 to 40 feet and all were finished in the Henry Formation Sands. They were slotted from at least five feet above the water table to the base. None of the holes reached bedrock. The hand auger borings in the creek bottom

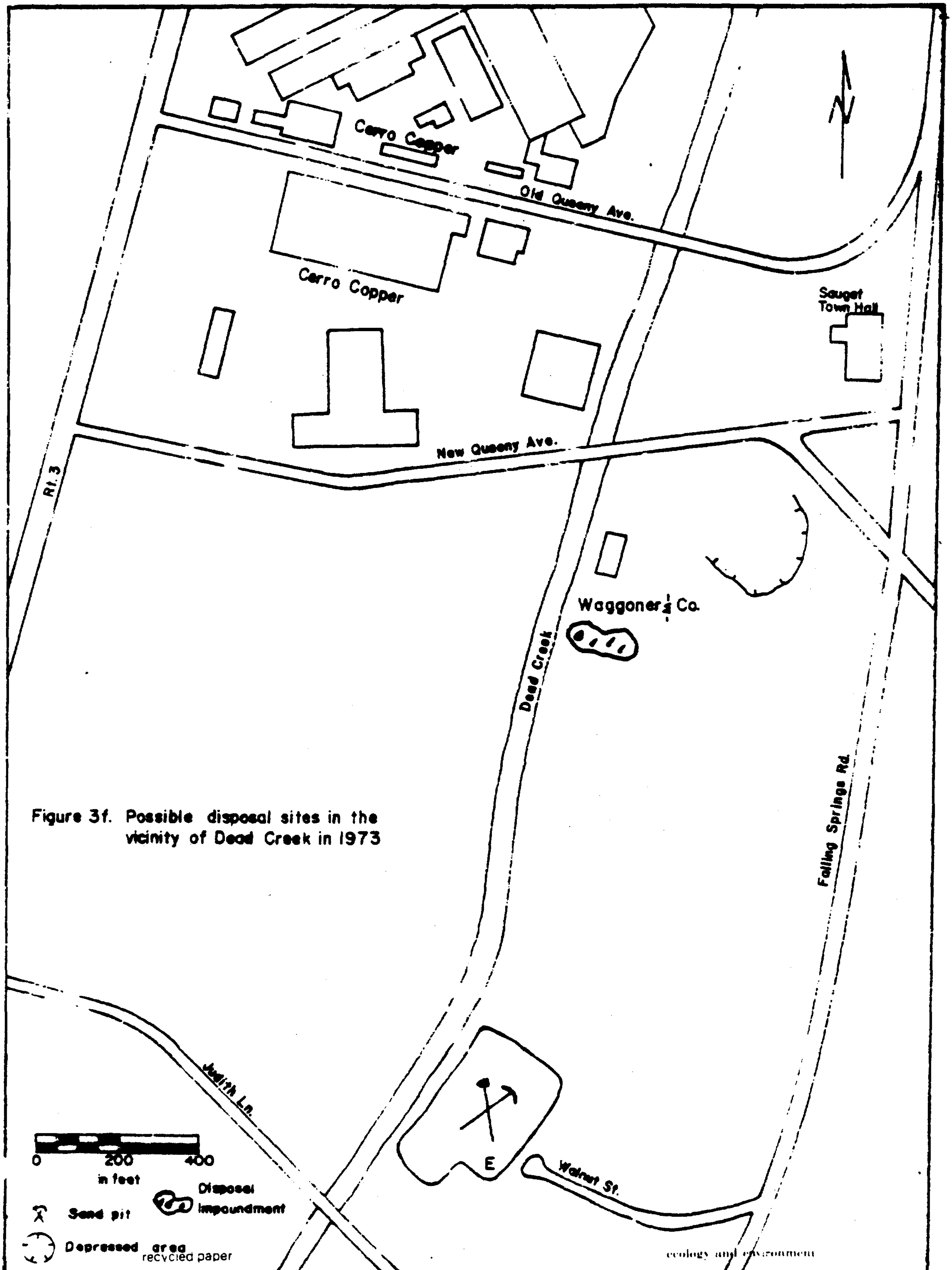

Figure 3f. Possible disposal sites in the vicinity of Dead Creek in 1973

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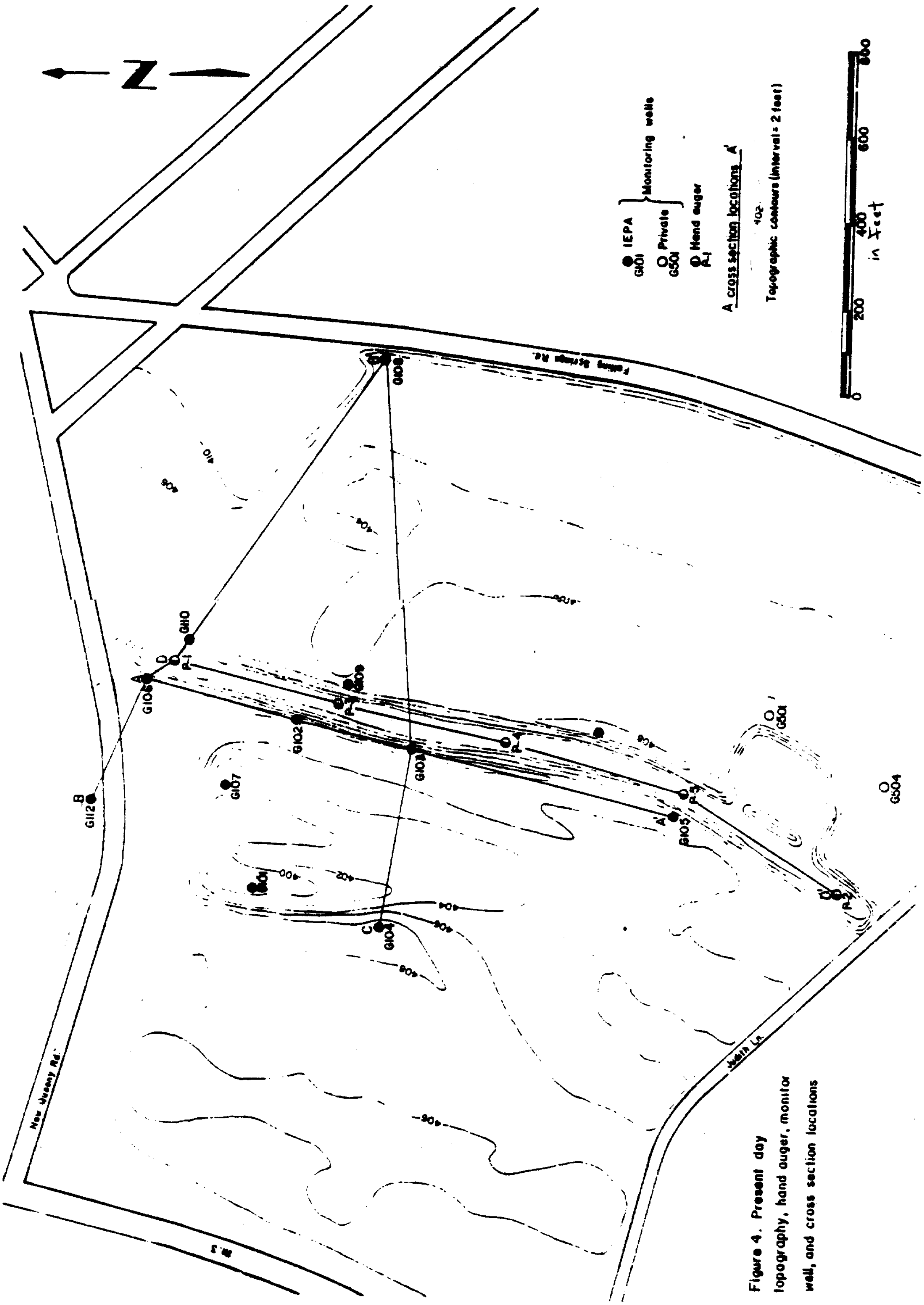

Figure 4. Present day topography, hand auger, monitor well, and cross section locations

were made to determine the thickness of the fill material. They ranged from 8 to 10 feet in depth and were finished upon reaching the Henry Formation Sands.

Geology

Dead Creek is situated in the Mississippi River flood plain on thick valley fill deposits (100'+). The valley fill is comprised of two formations, one of which is a thin mantle called the Cahokia Alluvium. Derived from the erosion of till and loess, the alluvium consists of unconsolidated, poorly sorted, silt, with some local sand and clay lenses. It appears to have accumulated in valleys during flood intervals after the Wisconsinan glaciers had retreated.

The Cahokia Alluvium formation unconformably overlies the Mackinaw Member of the Henry Formation. The Henry Formation is Wisconsinan glacial outwash in the form of valley train deposits. It accounts for the majority of the valley fill and is composed of sand and gravel that coarsens with depth. Due to the thickness and water capacity of this formation, it is a major aquifer for the East St. Louis area.

Mississippian limestone underlies the valley fill deposits at a depth of approximately 120 feet (Bergstrom, 1956).

Site Geology

Based on the 12 test holes, 5 hand auger borings, and the ISGS publications, a generalized rock stratigraphic column for shallow depths is shown in Figure 5. Cross sections (Figures 6a and 6b) show that geology at this site corresponds to the general description of the area previously given. The location of these cross sections appear on Figure 4.

Data from the 12 test holes indicates that the Henry Formation sand, which extends to bedrock, is overlain by the Cahokia Alluvium. The thickness of the alluvium is between 6 and 17 feet in the test holes and becomes thinner toward the east. The alluvium is primarily composed of silt with local clay and sand lenses, and also shows a tendency to be sandy at the base.

The Henry Formation is a major aquifer for the area and the portions sampled by the IEPA showed it to be an arkosic, gray, fine to medium grained sand. Former sand pits in the area were excavated to attain these sands.

Permeability values measured in the laboratory (Appendix 2), are in the order of 7×10^{-6} cm/sec and 4.4×10^{-3} cm/sec for the Cahokia Alluvium and Henry sands, respectively. Vertical distribution of permeability values are in Figure 6a.

Hand auger borings P-1 through P-5 were made in the creek bottom and they show that the material there is a fill composed of loosely compacted silty clay to clayey silt (Figure 6b). Because the velocity of creek flow was great enough to erode vertically at one time, a scouring in the creek through the upper silt mantle into the sand occurred. At a later date the energy of the stream decreased and the clayey silt now seen in the bottom of the creek was filled down into the Henry Formation sands. This deposit, since it is less consolidated than the older materials bounding it, is felt to have a permeability in the range of 1.0×10^{-6} cm/sec.

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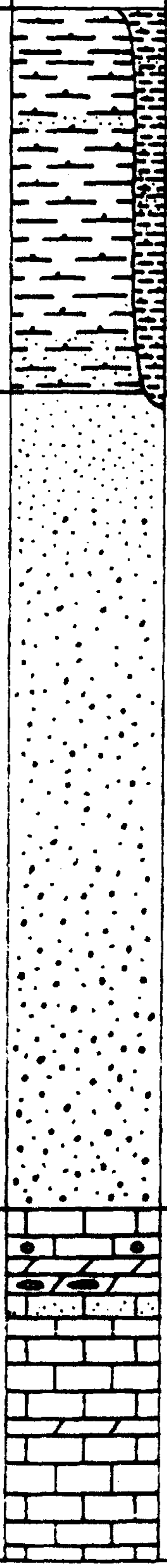
System	Series	Stage	Formation	Column	Thickness (in ft)	Description
Quaternary	Pleistocene	Holocene	Cahokia Alluvium		6-20	Silt, light tan, w/clay and fine sand locally, micaceous.
		Wisconsinan	Henry		100-114	Sand, tan, arkosic, fine grained at top coarsening downward to include some fine to medium grained gravel. Subrounded, moderately sorted. Contains: Quartz, chert, feldspars, limestone, ferro-magnesian minerals, shell fragments; wood chips and coal fragments at top.
		Group				
Mississippian	Valmeyeran	Middle Valmeyeran			100+	Limestone

Figure 5. Generalized Geologic Column for unconsolidated deposits to bedrock in the Dead Creek area.

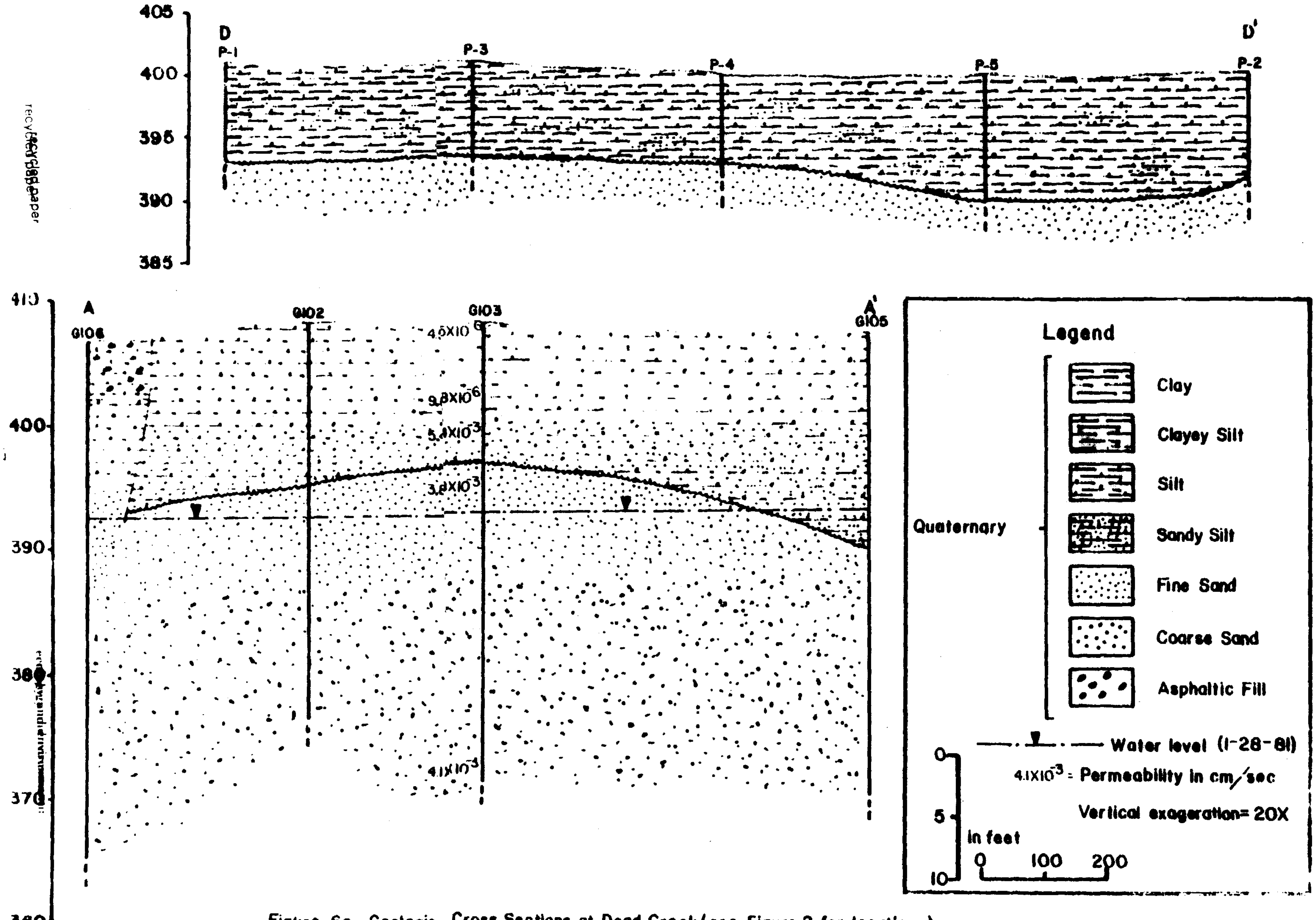
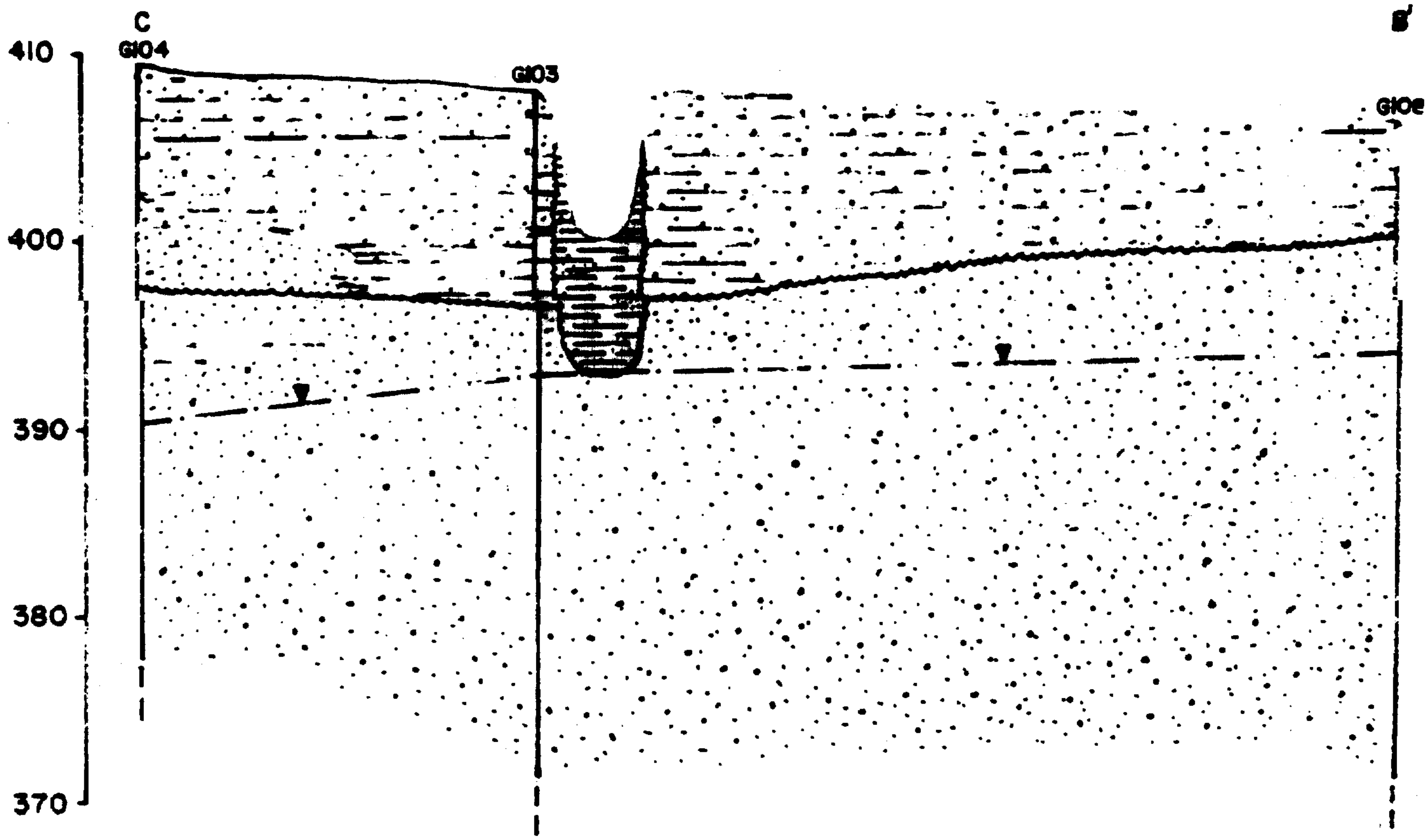


Figure 6a Geologic. Cross Sections at Dead Creek (see Figure 2 for locations)



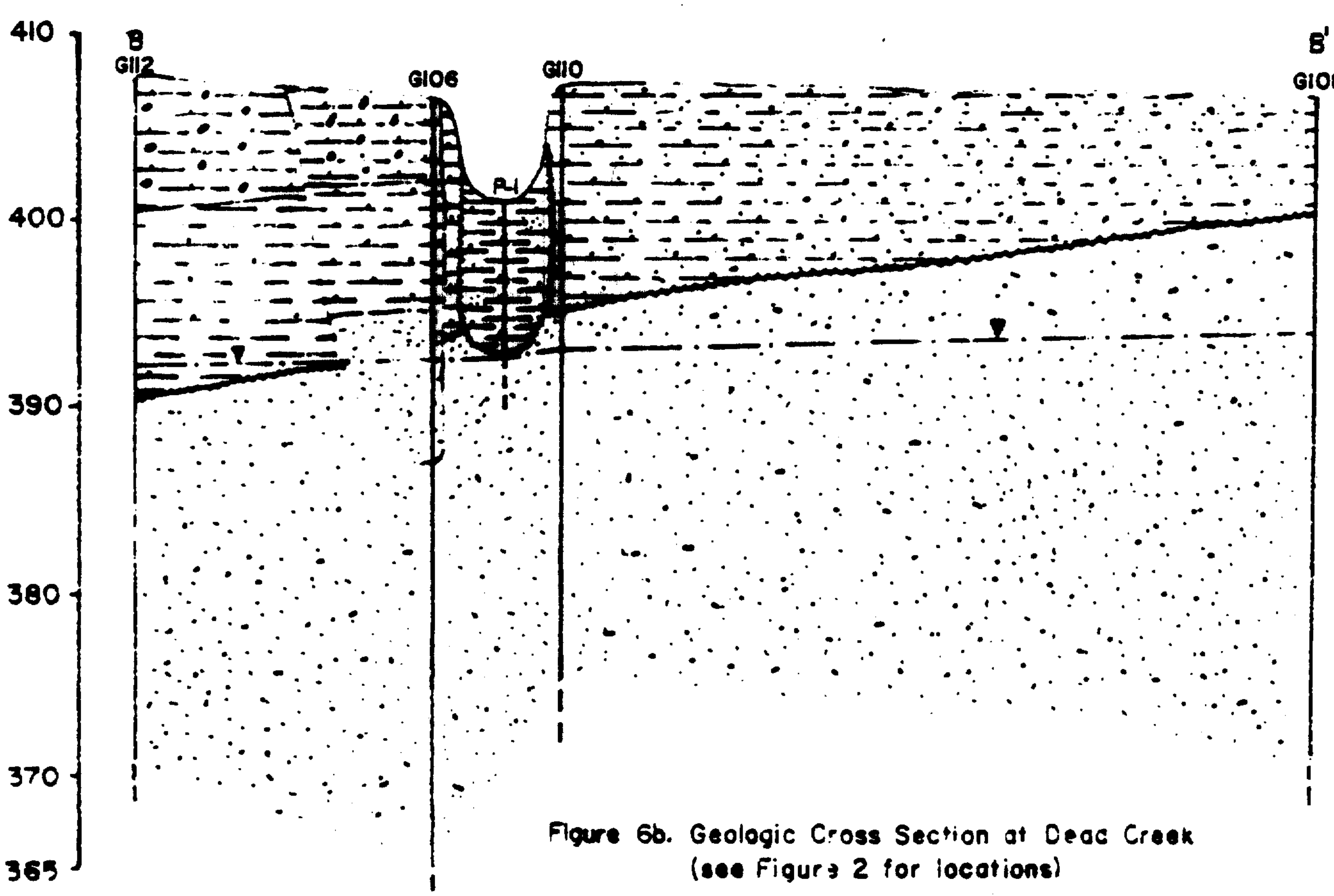


Figure 6b. Geologic Cross Section at Deac Creek
(see Figure 2 for locations)

Chemical Analyses of Soil

The soils adjacent to and in Dead Creek were sampled extensively to assess the impact of disposal practices. Results were evaluated to determine horizontal and vertical distribution of contaminants. The location of these samples is given in Figure 8 and analyses appear on Table 1. A general description of the soil analyses for Dead Creek is: 1) high concentrations of organics in the north end of the creek by New Queeny Avenue, 2) high concentrations of inorganics in the south away from New Queeny Avenue, and 3) slight vertical migration of inorganics and PCB from the surficial soils into the underlying sand deposits.

Surficial soils

Chemical analyses from surficial soil samples are listed in Table 1. In addition, the analyses of soil samples in monitoring wells G106, G107, and hand auger boring P-1 are discussed and presented in Figures 7a, 7b, and 7c. Over all, 31 soil samples were analyzed in the area, and sampling locations are shown in Figures 2 and 8.

Outside the boundaries of the creek bed itself five surficial soil samples, X119, X120, X121, G106, and G107, were taken and analyzed in an attempt to locate outside dumping sources. Analyses of these samples show relatively low concentrations of chemicals with the exception of PCB, which is .62 ppm, 1.1 ppm and 80 ppm at G107, X119, and X120 respectively. These samples lie in areas where past dumping of wastes is suspected.

The analysis of X121 had the lowest concentrations of chemicals when compared to all the other soil samples in the study. In fact, it showed the lowest concentrations of barium, cadmium, chromate, copper, lead, nickel, silver, sodium, strontium, and vanadium. Therefore, this sample is considered to be representative of background quality for soil in the area.

Surficial soil sampling outside the area of Dead Creek also took place in the holding ponds behind Cerro Copper's recycling plant. These ponds at one time were the head waters to Dead Creek. When flow was restricted under New Queeny Avenue, the creek was graded to the north so water would drain to a catch basin installed by Monsanto. The water entering this catch basin is then pumped to the Cahokia sewage treatment plant. Full restriction of flow under New Queeny Avenue is somewhat suspect as IEPA personnel have observed water flowing from the plug downstream in the creek. Since there is a storm sewer in the culvert it could account for this flow, but the possibility of the holding ponds backing up to cause flow must also be taken into consideration. Whatever the case might be, it is obvious that these holding ponds are highly polluted. Sediment samples X128 and X129 (Table 1) taken in them show PCB, aliphatic hydrocarbons, dichlorobenzene, silver and high concentrations of nickel, lead, cadmium, arsenic, copper, and manganese. In addition, the highest chromate concentration of 491 ppm was found in X129.

Sometime after 1950 the culvert at Judith Lane was blocked, but after reaching an undetermined level, it does flow. Water then moves downstream as shown in Figure 8 to the Prairie DuPont Floodway. IEPA personnel have sampled the soils from the creek along its path to the Floodway and the analyses appear in Table 1. When downstream soil samples X101, X102, X103, X104, and X105 are compared to the background soil sample X121 (Table 1) it is seen that they contain relatively high concentrations of aluminum, barium, boron, cadmium, chromate, copper, lead.

Table 1. Chemical analysis of soils (in ppm, dry weight material)

Parameters	Sample number X101	X102	X103	X104	X105	X106	X107
Aluminum	12,000	NA	NA	NA	NA	NA	NA
Arsenic	26.0	NA	NA	NA	NA	NA	6,000
Barium	1,300	4,700	210	390	475	NA	4,800
Berylium	< 4.0	3.0	< 0.5	2.0	< 1.0	NA	< 1.0
Boron	< 10.0	76.0	< 10.0	< 10.0	< 10.0	NA	NA
Cadmium	< 40.0	50.0	8.0	31.0	2.0	NA	70.0
Calcium	24,000	5,300	210,000	16,000	13,000	NA	11,000
Chromium	400	50.0	60.0	50.0	< 50.0	NA	360
Cobalt	40.0	32.0	6.0	8.0	9.0	NA	30.0
Copper	15,000	17,200	320	1,800	360	NA	32,000
Iron	57,000	110,000	11,000	19,000	18,000	NA	70,000
Lead	800	1,300	260	250	75.0	NA	2,400
Magnesium	7,100	2,000	10,000	5,100	3,300	NA	2,900
Manganese	600	170	210	160	200	NA	150
Mercury	1.2	NA	NA	NA	NA	NA	NA
Nickel	2,000	2,300	45.0	600	< 50.0	NA	3,500
Phosphorus	NA	6,200	720	1,200	4,200	NA	7,040
Potassium	2,400	900	1,400	2,100	1,400	NA	1,200
Silver	< 100	45.0	10.0	< 10.0	< 10.0	NA	40.0
Sodium	800	1,100	100	190	125	NA	1,700
Strontium	100	140	210	47.0	43.0	NA	180
Vanadium	< 80.0	50.0	22.0	31.0	35.0	NA	60.0
Zinc	12,000	21,000	900	5,600	780	NA	25,000
PCB	.120	.120	2.8	2.0	< .050	5,200	120
Aliphatic hydrocarbons	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alkylbenzenes	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloronitrobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dichlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dichlorophenol	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hydrocarbons	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalenes	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichlorobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Table 1. Chemical analysis of soils (in ppm, dry weight material) (cont)

Parameters	Sample number						
	X108	X109	X110	X111	X112	X113	X114
Aluminum	8,000	9,100	7,000	8,000	6,600	10,000	6,400
Arsenic	44.0	25.0	67.0	80.0	50.0	300	23.0
Barium	3,800	1,600	4,300	1,800	8,000	2,400	1,600
Berylium	<4.0	<4.0	<4.0	<5.0	<5.0	<5.0	<3.0
Boron	<10.0	<10.0	<10.0	<15.0	<15.0	NA	<7.0
Cadmium	<30.0	200	40.0	100	100	400	<10.0
Calcium	10,000	24,000	16,000	13,000	30,000	11,000	14,000
Chromium	300	<40.0	140	50.0	50.0	250	400
Cobalt	30.0	20.0	<20.0	<30.0	30.0	100	<20.0
Copper	31,000	7,700	22,000	15,000	41,000	3,800	4,800
Iron	58,000	75,000	67,000	68,000	52,000	365,000	55,000
Lead	2,000	1,700	2,000	2,000	5,100	3,600	2,000
Magnesium	3,900	3,600	4,100	4,000	4,000	4,000	2,800
Manganese	150	300	200	160	300	120	130
Mercury	1.7	3.0	3.3	3.2	6.0	30	1.7
Nickel	3,000	900	1,900	2,000	2,700	2,500	1,700
Phosphorus	NA	NA	NA	NA	NA	NA	NA
Potassium	1,500	1,700	1,300	1,600	1,200	1,400	1,300
Silver	<80.0	<50.0	<90.0	<50.0	<100	<100	<70.0
Sodium	900	900	700	1,000	1,600	2,800	700
Strontium	200	130	160	160	430	180	140
Vanadium	<70.0	<80.0	70.0	100	<50.0	<100	<50.0
Zinc	22,000	27,000	25,000	47,000	52,000	61,000	20,000
PCB	NA	NA	NA	NA	NA	NA	NA
Aliphatic hydrocarbons	NA	NA	NA	NA	NA	NA	NA
Alkylbenzenes	NA	NA	NA	NA	NA	NA	NA
Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA
Dichlorophenol	NA	NA	NA	NA	NA	NA	NA
Hydrocarbons	NA	NA	NA	NA	NA	NA	NA
Naphthalenes	NA	NA	NA	NA	NA	NA	NA
Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA

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Table 1. Chemical analysis of soils (in ppm, dry weight materials) (cont)

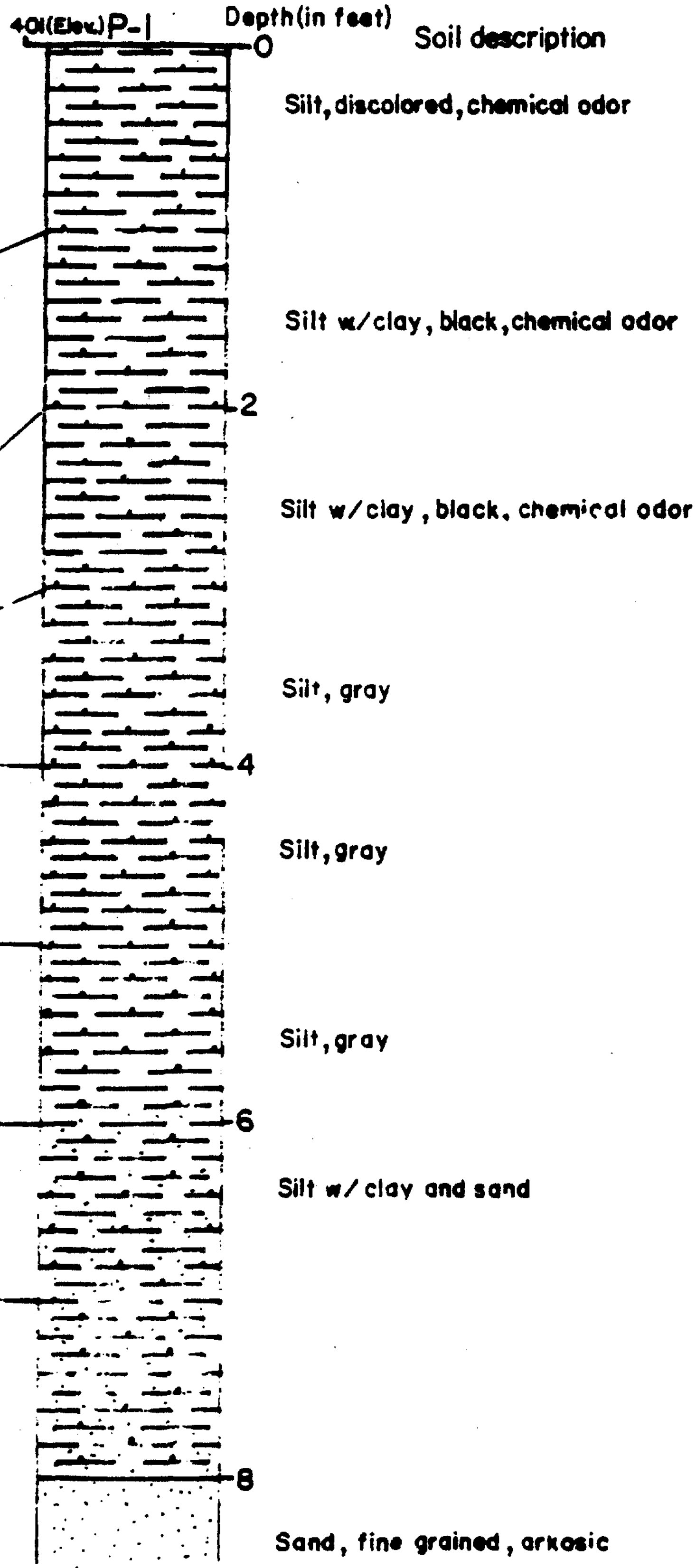
Parameters	Sample number						
	X115	X116	X117	X118	X119	X120	X121
Aluminum	9,000	9,000	1,300	1,200	NA	NA	NA
Arsenic	18.0	9.0	16.0	15.0	NA	NA	NA
Barium	3,400	300	400	1,600	510	1,200	230
Berylium	<7.0	<2.0	<2.0	<2.0	1.0	1.0	<1.0
Boron	<20.0	<20.0	<10.0	6.0	<10.0	<10.0	<10.0
Cadmium	120	<20.0	<30.0	<20.0	7.0	3.0	1.0
Calcium	11,000	5,000	1,600	6,000	7,300	72,000	11,000
Chromium	120	130	<40.0	<30.0	36.0	38.0	<10.0
Cobalt	40.0	<10.0	<20.0	<4.0	9.0	10.0	9.0
Copper	22,000	270	160	1,000	100	150	100
Iron	40,000	12,000	2,400	4,300	17,500	16,200	16,500
Lead	3,200	80.0	<40.0	100	43.0	60.0	<20.0
Magnesium	5,000	2,600	1,200	1,000	4,500	4,300	5,900
Manganese	150	60	40.0	50.0	260	350	370
Mercury	4.0	0.2	2.0	2.0	NA	NA	NA
Nickel	2,400	140	<20.0	<15.0	<10.0	80.0	120
Phosphorus	NA	NA	NA	NA	NA	NA	NA
Potassium	1,500	2,300	850	1,200	1,800	1,200	1,500
Silver	<100	<50.0	50.0	<50.0	<10.0	<10.0	<10.0
Sodium	1,100	360	150	180	110	225	80.0
Strontium	200	40.0	<30.0	<30.0	42.0	140	32.0
Vanadium	150	<50.0	<40.0	<50.0	27.0	27.0	25.0
Zinc	71,000	2,500	<50.0	300	2,000	700	230
PCB	NA	NA	NA	NA	1.1	80.0	<.05
Aliphatic hydrocarbons	NA	NA	NA	NA	BDL	BDL	BDL
Alkylbenzenes	NA	NA	NA	NA	BDL	BDL	BDL
Dichlorobenzene	NA	NA	NA	NA	BDL	BDL	BDL
Dichlorophenol	NA	NA	NA	NA	BDL	BDL	BDL
Hydrocarbons	NA	NA	NA	NA	BDL	BDL	BDL
Naphthalenes	NA	NA	NA	NA	BDL	BDL	BDL
Trichlorobenzene	NA	NA	NA	NA	BDL	BDL	BDL

Table 1. Chemical analysis of soils (in ppm., dry weight materials) (cont.)

Parameters	Sample number							
	X122	X123	X124	X125	X126	X127	X128	X129
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	29.5	95.8
Barium	5,500	4,400	350	2,500	5,000	2,500	NA	NA
Berylium	2.0	3.0	1.0	<1.0	2.0	2.0	NA	NA
Boron	<10.0	<10.0	25.0	<10.0	76.0	<10.0	NA	NA
Cadmium	35.0	40.0	4.0	6.0	70.0	50.0	50.6	22.11
Calcium	15,000	12,500	4,500	6,900	19,000	8,000	NA	13,095
Chromium	50.0	150	50.0	50.0	100	340	140	491
Cobalt	15.0	15.0	7.0	9.0	50.0	30.0	NA	NA
Copper	21,900	18,700	4,500	1,000	44,800	28,000	5.5	24,324
Iron	50,000	49,000	13,500	7,000	107,000	63,000	29,535	51,911
Lead	1,700	1,400	130	260	2,000	1,700	843	2,604
Magnesium	3,800	3,400	3,500	380	3,700	2,700	NA	2,088
Manganese	190	200	80.0	45.0	280	150	141	245
Mercury	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	1,700	1,600	590	130	3,000	NA	569	1,474
Phosphorus	NA	NA	NA	2,000	8,900	4,700	NA	NA
Potassium	960	950	1,000	770	860	1,000	NA	NA
Silver	30.0	30.0	6.0	<10.0	100	40.0	29.0	98.0
Sodium	630	650	100	80	1,400	700	NA	NA
Strontium	190	175	27.0	50.0	300	130	NA	NA
Vanadium	45.0	42.0	19.0	13.0	85	45.0	NA	NA
Zinc	19,900	17,700	2,600	1,500	62,000	28,000	NA	NA
PCB	540	1,100	24.0	10,000	350	73.0	2.2	13.0
Aliphatic hydrocarbons	BDL	BDL	BDL	BDL	BDL	BDL	13.0	26.0
Alkylbenzenes	BDL	BDL	BDL	370	BDL	BDL	BDL	BDL
Dichlorobenzene	0.35	23.0	BDL	660	BDL	BDL	BDL	1.7
Dichlorophenol	BDL	BDL	BDL	170	BDL	BDL	BDL	BDL
Hydrocarbons	BDL	BDL	BDL	21,000	BDL	BDL	BDL	BDL
Naphthalenes	BDL	BDL	BDL	650	BDL	BDL	BDL	BDL
Trichlorobenzene	BDL	BDL	BDL	78	BDL	BDL	BDL	BDL

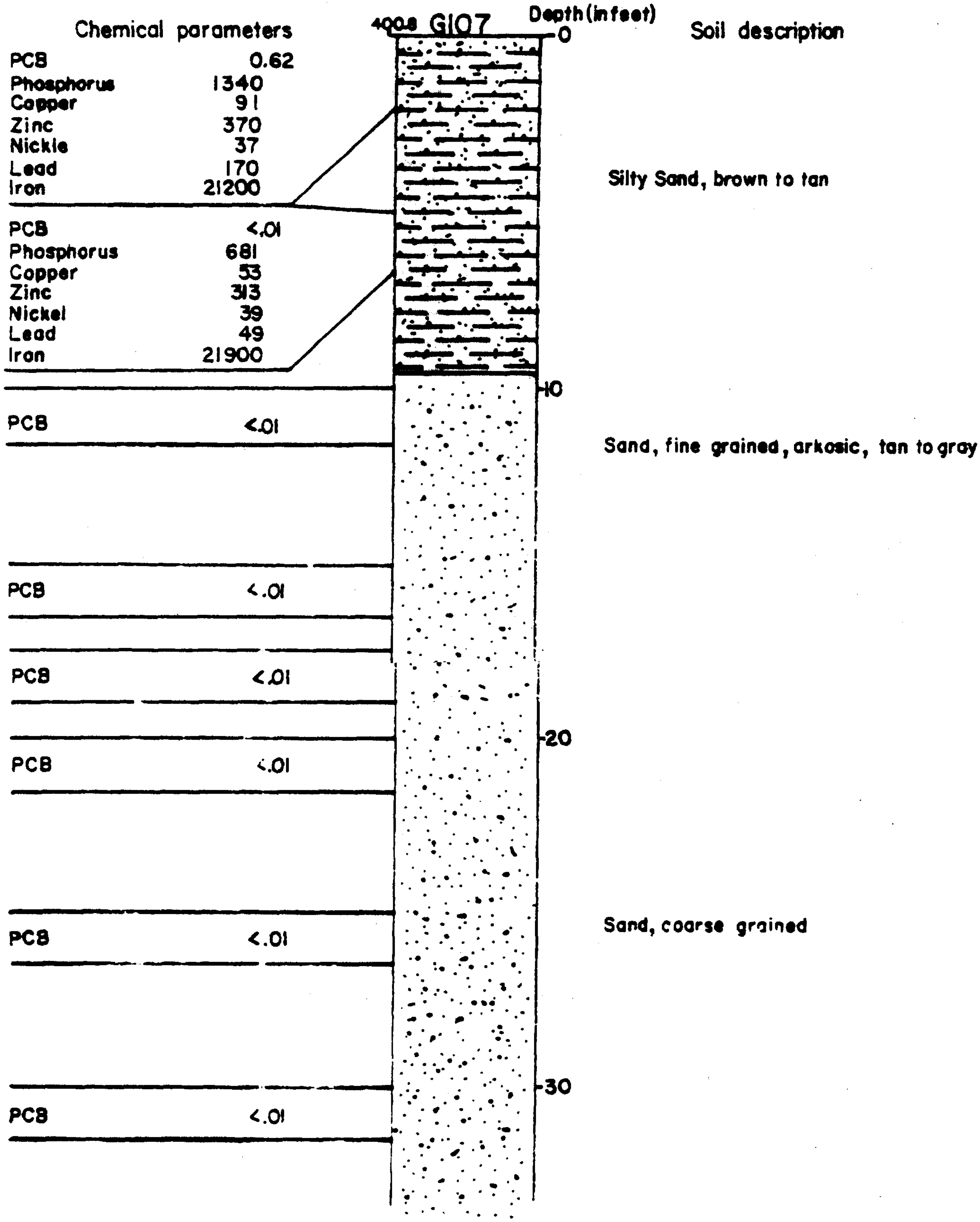
NA - not attempted
BDL - below detection limit
All samples taken between 9/8/80 and 11/26/80

Chemical parameters	
PCB	9200
Xylene	540
Dichlorobenzene	12000
Trichlorobenzene	380
Chloronitrobenzene	200
Biphenyl	6000
PCB	2600
Xylene	250
Dichlorobenzene	8900
Trichlorobenzene	3700
Chloronitrobenzene	240
Biphenyl	9000
PCB	920
Dichlorobenzene	240
Trichlorobenzene	590
Biphenyl	1100
PCB	240
PCB	53
PCB	53
PCB	54



All concentrations in ppm

Figure 7a. Vertical distribution of organic chemicals in the creek bottom at P-1



All concentrations in ppm

Figure 7b. Vertical distribution of PCB's and metals at G107

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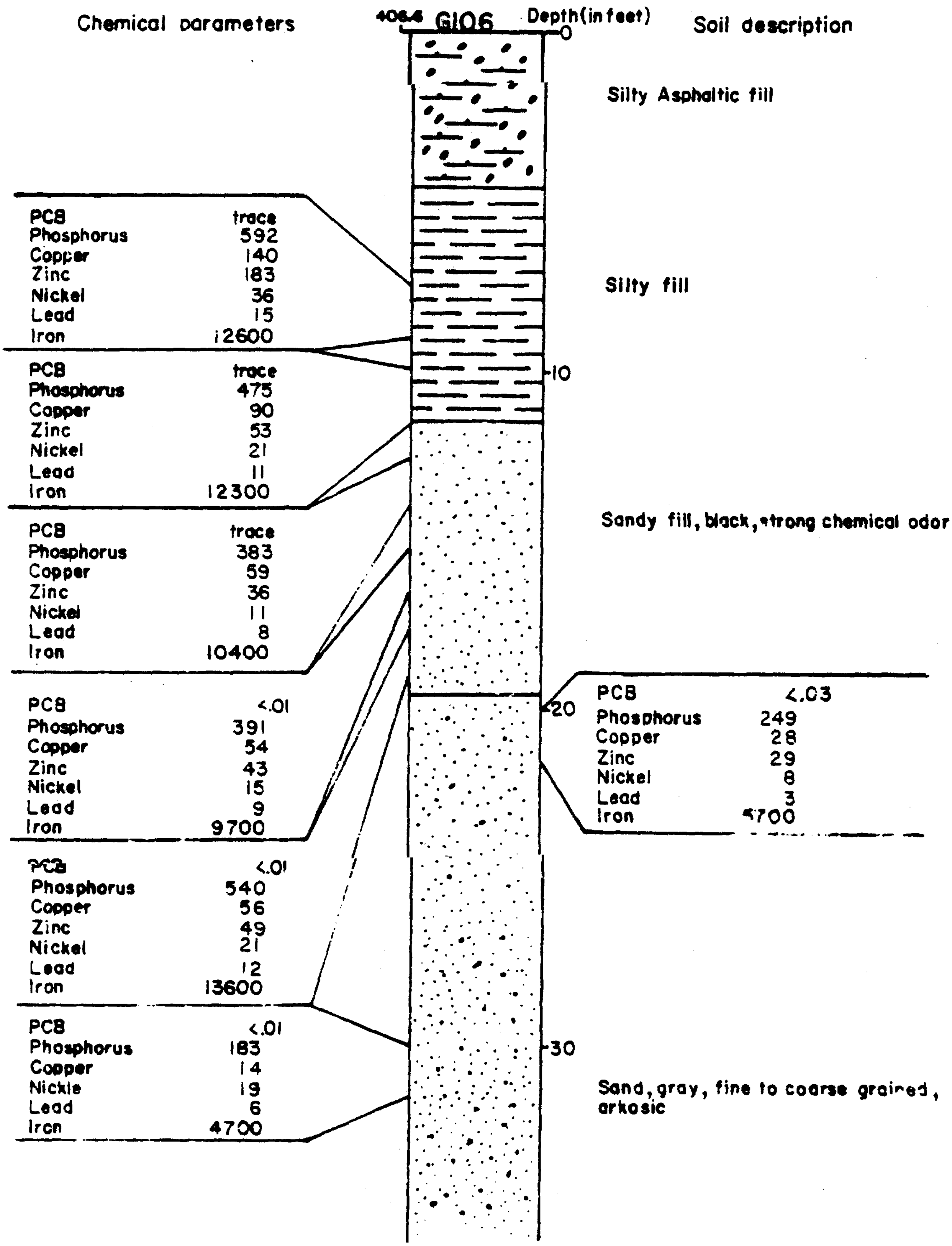

All concentrations in ppm

Figure 7c. Vertical distribution of PCB's and metals at GIO6

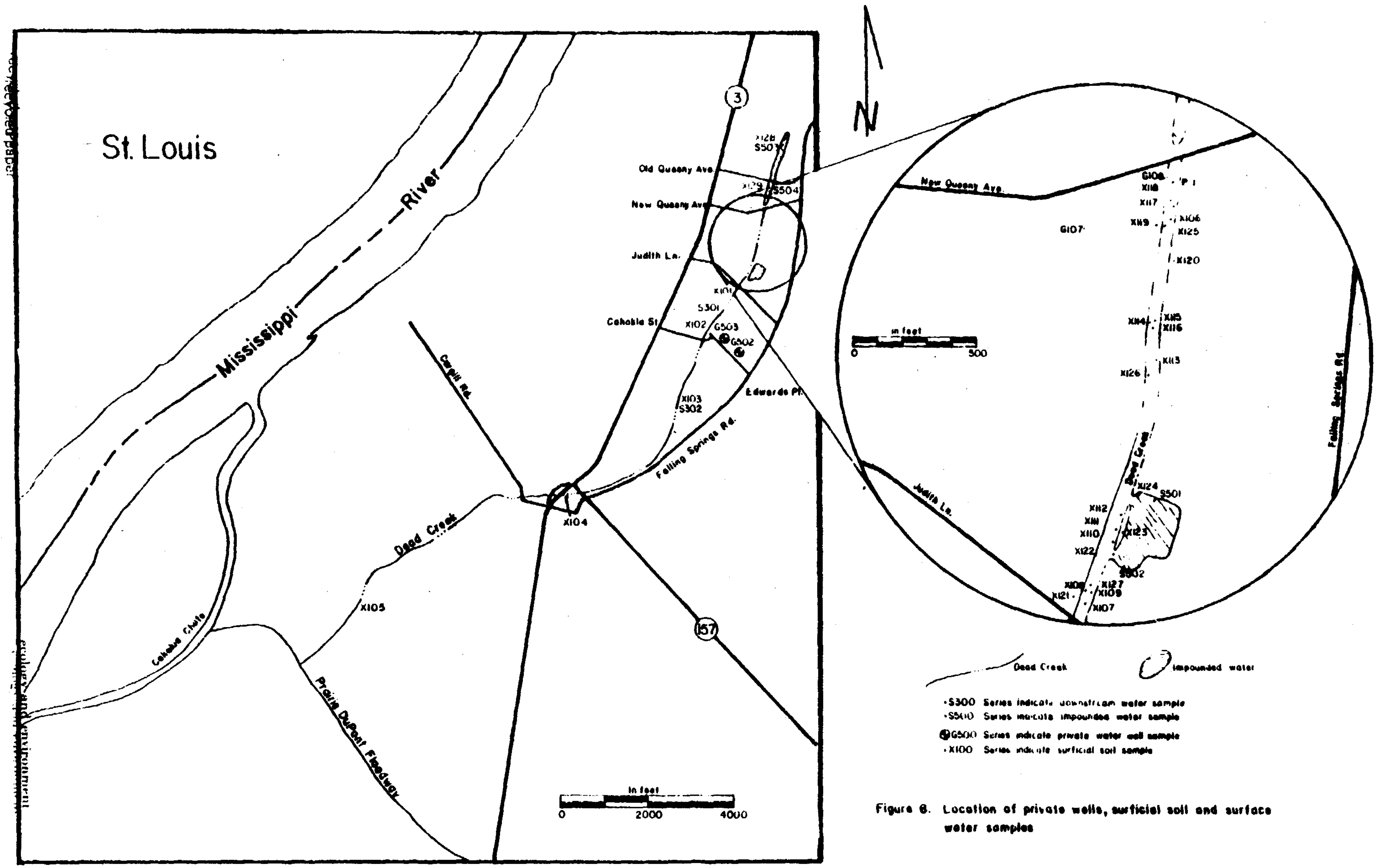

Figure 8. Location of private wells, surficial soil and surface water samples

nickel, sodium, strontium, and zinc. In fact, the highest concentrations of aluminum (12,000 ppm) and boron (76 ppm) are associated with these downstream soil samples. The relatively high concentrations in the downstream soil samples is due to transportation by the creek of the soils from upstream. It is noticed that at some locations concentrations are higher even though they are further downstream (X104 compared to X103). This can be attributed to dynamic properties of stream flow such as gradient, channel depth, and channel form. Besides the creek soils, unknown waste disposal activities at downstream locations might cause the high concentrations in soils. The only organic chemical to show up downstream was PCB, and it ranged from less than .05 ppm at X105 to 2.8 ppm at X103.

Soil samples taken in the creek bed between New Queeny Avenue and Judith Lane can be grouped into three areas (Figure 8), north, central, and south. Samples X106, X117, X118, X125, and the first sample of P-1 are surficial soil samples at the north end of the creek. When compared to the background sample X121, the analyses from the five samples above indicate that they contain very high levels of organic chemicals. The highest concentrations are PCB (10,000 ppm), dichlorobenzene (12,000 ppm), xylene (540 ppm), trichlorobenzene (380 ppm), chloronitrobenzene (200 ppm), biphenyl (6,000 ppm), dichlorophenol (170 ppm), alkylbenzenes (370 ppm), naphthalenes (650 ppm), and hydrocarbons (21,000 ppm). Although concentrations of these chemicals show drastic changes from one sample to another in the same area, it appears that sample P-1 has the highest concentration of organics. Most of the organics are not detected in samples X106 even though it is close to samples X125 and P-1. The difference is probably caused by both the creek bed topography, where an accumulation of organics has occurred in depressions and/or differences in permeability of the creek bed soils that might cause differential migration of organics downward from the soil surface. Inorganic chemicals are relatively high in comparison to the background sample in the northern part of the creek as well.

Five soil samples, X113, X114, X115, X116, and X126, were taken in the central portion of Dead Creek. Among these, only X126 was analyzed for organics and was found to contain only PCB (350 ppm). Analysis results indicate that this area contained very high levels of inorganics. The highest concentration for cadmium (400 ppm), cobalt (100 ppm), iron (365,000 ppm), mercury (30 ppm), sodium (2,800 ppm) are associated with X113. In addition, the highest concentration of zinc (71,000 ppm) was found at X115, chromate (400 ppm) at X114, and that of boron (76 ppm), copper (44,800 ppm) and phosphorus (8,900 ppm) at X126. In general, inorganic chemicals in this portion of the creek exceed background levels by several times.

Soil samples X107, X108, X109, X110, X111, X112, X122, X123, and X124 were taken in the southern part of the creek and near the pond. PCB was found in relatively high concentrations in X107 (120 ppm), X122 (540 ppm), X123 (1,100 ppm), X124 (24 ppm) and X127 (73 ppm). Also, 0.35 ppm and 23 ppm dichlorobenzene was found in X122 and X123, respectively. As for inorganics, the highest concentration of barium (8,000 ppm), lead (5,100 ppm), and strontium (430 ppm) are at X112, nickel (3,500 ppm) at X107, and that of vanadium (100 ppm) at X111. In general, the other inorganics are relatively high and above the background (X121) concentrations.

Vertical Distribution

Vertical distribution of chemicals in soils is examined in three locations, G106, G107, and P-1 (Figure 8), the results are presented in Figures 7a, 7b, and 7c.

Inorganic chemicals are analyzed in two locations, G106 and G107, to obtain data outside the creek bed itself. At G106, traces of PCB are shown in the upper three intervals. The metal concentrations show a general decrease with depth, however, analysis at G106 indicates that the metal concentrations of the upper silty fill and the sand immediately below are almost the same. At G107, only the two uppermost samples have been analyzed for metals, and although the data is incomplete, it seems metals and PCB increases with depth. Soils at G107 seem to contain a higher concentration of chemicals than those at G106. This would suggest waste disposal activity nearby. Presently, there is an open dump north of G107. This dump is bounded by the Weise Machinery building on the west, G107 on the south, New Queeny Avenue on the north, and G106 on the east.

Soil samples from P-1, located at the northern part of the creek bed, were analyzed for organics. The three surficial soil samples, to a depth of 3 feet, contain large amounts of PCB and organics. Below this interval, a decrease of organic chemicals is noted with depth, though there is a slight discrepancy with trichlorobenzene and chloronitrobenzene. Except PCB, other organics are not found below 3 feet in depth. Analyses indicate that most of the organics are confined to surficial soils and do not tend to travel vertically. This is probably due to both clay content of surficial soils, and the relatively low solubility of chlorinated hydrocarbons and their associated by products. PCB's show a slight vertical migration that probably reaches the Henry Formation sands and thus the ground water in minor amounts. Outside the creek bed very low amounts of PCB were found but other organics were not; inorganics appear to have traveled downward to some degree.

Ground Water

Aquifer

As stated previously, the Henry Formation sands are the major aquifer in the area. At the creek itself these valley train sands, on an average, rise to within 14 feet of surface. Figures 6a and 6b show the potentiometric level plotted at the site in cross section. It is seen by these cross sections that most of the ground water occurs in the Henry Formation sands. Exceptions occur in the northern and southern portions of the creek where the silt mantle thickens (Figure 6a, A-A') and the ground water level encounters it.

Water table as opposed to leaky artesian conditions (Bergstrom, 1956) prevail at the site because the lower portion of the alluvial silt is permeable enough (5.4×10^{-3}) not to impede vertical movement of the ground water.

The potentiometric surface map, Figure 9, indicates that the hydraulic gradient is very flat in the vicinity of Dead Creek. The gradient is 3'/1060' or .00283 generally moving to the west but with local fluctuations apparent. Periodic measurement of the potentiometric surface appear in Table 2. The following is a brief discussion of potential pollution sources and their impact on ground water.

Table 2. Ground water elevations in IEPA monitor wells, all elevations in feet above mean sea level

Well number	10/22/80 10/23/80	10/30/80	10/31/80	1/28/81	2/18/81
	Measurement dates				
G101	393.02	393.22	393.42	391.82	391.52
G102	394.29	394.49	394.09	392.79	392.69
G103	394.40		393.70	393.00	392.70
G104	393.60	393.70	393.40	390.60	392.00
G105	394.81	394.91	394.51	393.31	392.91
G106	394.17	394.17	394.87	392.57	392.77
G107	390.05	393.35	391.05	392.75	391.85
G108	395.06	395.26	394.16	394.26	393.96
G109	394.38	394.18	393.78	392.68	392.18
G110	394.74	394.64	394.34	393.44	393.04
G111		394.21	393.91	393.21	392.61
G112		394.32		392.32	392.22

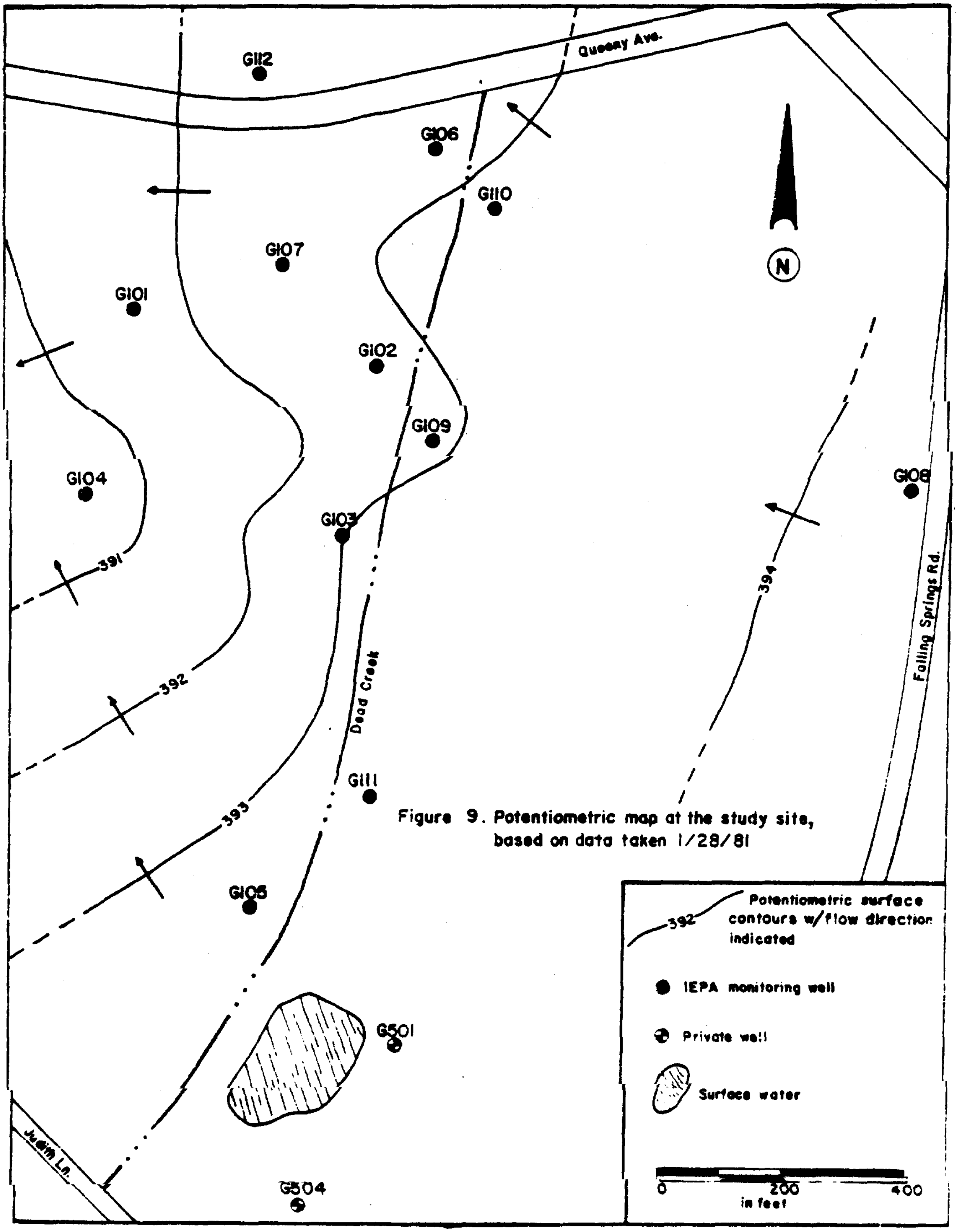

Figure 9. Potentiometric map at the study site, based on data taken 1/28/81

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Dead Creek

Conditions in the creek are suspected of being a major contributor to ground water pollution. As seen in Figure 6b (cross sections C-B' and B-B'), the water table is just at the bottom of the creek fill material. This level is at its lowest point for the year though. Using information gathered from another site in the American Bottoms (East St. Louis/SCA-Milam), this level can be expected to rise approximately 3.65 feet at its peak level of the year. When this occurs, polluted fill material comes in contact with ground water. The ground water at this time produces a washing of these pollutants from the creek fill. Darcy's equation allows us to calculate the rate of flow beneath the creek in the sand aquifer and thus the rate at which these pollutants are washed away.

Darcy's equation: $Q = K \times \frac{dh}{dl} \times A$ where,

Q = flow rate
K = hydraulic conductivity (permeability)
$\frac{dh}{dl}$ = hydraulic gradient
A = cross section area through which water flows perpendicular to

At the creek the following conditions exist:

K = the average permeability of the aquifer is given to be 4.4×10^{-3} cm/sec or 4454 ft/year

$\frac{dh}{dl}$ = the hydraulic gradient is determined to be .00282

A = the area perpendicular to flow, using the 3.65 foot rise of the water table is 7210 square feet.

This data yields the following:

$$Q = K \times \frac{dh}{dl} \times A$$

$$Q = (4554 \text{ ft/year}) \times (.00283) \times (7210 \text{ ft}^2)$$

$$Q = 92{,}921 \text{ ft}^3\text{/year or } 1.32 \text{ gal/min}$$

At the same time an approximation of velocity, V, can be calculated for the water in the aquifer. This is the velocity at which the pollutants contributed by the creek move away from it. Here,

$$V = K \times \frac{dh}{dl} \times \frac{1}{N} \text{ where}$$

V = velocity and N = effective porosity.

It is assumed that the effective porosity of the Henry Formation sands is 0.20 (Walton, 1970) which gives the following:

$$V = (4554 \text{ ft/year}) \times (.00283) \times \frac{1}{0.20} = 64.4 \text{ ft/year or } 0.18 \text{ ft/day}$$

The period of time required for surface water to infiltrate the bottom of the creek and travel through the fill to ground water can be calculated from:

$T = \frac{L}{V}$ where,

T = time required
L = distance traveled (thickness of layer)
V = velocity

The velocity of water movement through the fill can be calculated by the equation used previously. If it is assumed that the fill material with a permeability of 1.0×10^{-6} has an effective porosity of .10 and thickness of 8 feet under unit hydraulic gradient, this yields:

$$V = K \times \frac{dh}{dl} \times \frac{1}{N} \text{ and}$$

$$V = (1.03 \text{ ft/year}) \times (\frac{8 \text{ ft}}{8 \text{ ft}}) \times \frac{1}{.10} = 10.30 \text{ ft/year or } .0282 \text{ ft/day}$$

The time required for movement of water through the fill can now be calculated in the northern part of the creek where the fill is 8 feet thick as,

$$T = \frac{L}{V}$$

$$T = \frac{8 \text{ feet}}{10.30 \text{ ft/year}} = .777 \text{ years or } 284.0 \text{ days}$$

and at the south end of the creek where the fill material thickens to 10 feet as,

$$T = \frac{L}{V}$$

$$T = \frac{10}{10.30 \text{ ft/yr}} = .9708 \text{ years of } 354.0 \text{ days}$$

This means that if the fill in the creek is saturated and there is only a film of liquid in the creek, that it will take between 284 to 354 days to reach the ground water. However, if large amounts of liquid wastes are disposed of in the creek or much water exists in the creek after a rain, vertical migration is probably much more rapid.

Due to complexities involving surrounding surface runoff and infiltration percentage of precipitation, the flow rate through this layer cannot be calculated.

Holding ponds at Cerro Copper

Prior to blocking the culvert at New Queeny Avenue the impounded waters on Cerro Copper were once the head waters for Dead Creek. Because of this, it is assumed that the morphology is similar and that the time required for the impounded water to infiltrate through the creek fill is much less than that calculated for the northern portion of the creek, 284 days. This is because the impounded water results in a larger head and increases the velocity of the ground water movement. Becker (1975) identified four outfalls entering this pond from the Cerro Copper plant.

The Disposal Impoundment

As seen in a 1973 map by the U.S.A.C.E. (St.Louis District), the area of the disposal impoundment is approximately 20,000 square feet. The wastes dumped into it and the later leaching by rain water are then sources of potential ground water pollution here.

Mr. Waggoner stated in 1971 that he used approximately 100 gallons of water per day to wash out his trucks that carried industrial waste. This is most likely a conservative estimate. He operated in this manner from August, 1971 until sometime in 1974, when he sold the company to Ruan Trucking Company, who continued the same practice until 1978. If it's assumed that they "washed their trucks out" 5 days a week during this period of time, the following estimate as to the amount of disposal can be made:

(100 gal/day) x (6.3 years) x (52 weeks/year) x (5 days/week) = 163,800 gallons

It is felt that this excavation caused large amounts of ground water pollution, as seen from the above value, and from the drilling of monitor well G109 (Figure 4). While drilling it, the driller and his assistant operating the rig became nauseous from the fumes. These conditions were due to its location in a small strip of virgin soil between the creek and the disposal impoundment. Since the soils above the water table are relatively clean until encountering the ground water, and no mounding is shown at this well location, it must be assumed that the disposed liquids migrated vertically from the impoundment. Upon encountering the ground water table, pollutants traveled in the direction of ground water flow (to the west), and reached well G109.

The Pond Occupying H. H. Hall Construction's Sand Pit

The water level in this pond is 1.5 to 2.0 feet higher than the closest wells to it (G111, G105), therefore, it is assumed that the water in the pond has no hydrological connection to the ground water aquifer. Since this pit was excavated to obtain the Henry Formation sands, it at one time must have extended down to the aquifer. The only explanation for this breech then, is that the pond has silted in to the point where the water in the pond is of a perched nature. This silting action occurred in the same way as that previously described for the creek bottom. Evidence for the deposition of this silt fill in recent times occurs at the Judith Lane culvert. This culvert (with a diamter of 6 feet) was installed in the early 1950's to allow for better creek flow under the road. Subsequent sedimentation in the creek has filled to within one foot of the top of this culvert. This means that the water level in the pond fluctuates independently of the ground water aquifer.

Water Quality

Ground Water

The monitoring wells installed by the IEPA have been sampled twice during this study. The location of these wells are shown on Figure 4, and analysis results are presented in Tables 4a and 4b. In addition to these wells, four private wells (Figures 4 and 8) have been sampled to establish the background quality. Water samples were collected and preserved according to the Agency standards, however, the samples were not filtered. Analysis for the background is in

Table 3. Ground water quality in private wells (background), concentrations in ppm except where noted

Parameters	Ground water standards	Collection date and well number			
		9/16/80 G501	9/16/80 G502	9/16/80 G503	9/23/80 G504
Arsenic	0.05	0.008	0.004	0.001	< 0.001
Barium	1.0	0.2	0.16	0.39	0.05
Boron	1.0	0.28	0.27	0.25	0.58
Cadmium	0.01	<0.001	< 0.005	< 0.002	< 0.002
Chromium	1.05	<0.01	< 0.005	< 0.01	NA
Copper	0.02	0.02	< 0.005	< 0.005	0.06
Iron	1.0	4.6	19.0	17.7	0.73
Lead	0.05	< 0.02	< 0.02	< 0.05	< 0.04
Magnesium	NE	33.0	39.0	36.0	30.0
Manganese	0.15	1.02	1.26	0.79	0.65
Mercury	0.0005	< 0.0001	< 0.0001	< 0.0001	0.0001
Nickel	1.0	< 0.005	< 0.0005	< 0.01	0.02
Phosphorus	0.05	< 1.0	< 1.0	< 1.0	0.2
Potassium	NE	6.6	5.7	4.5	6.0
Silver	0.0005	< 0.005	< 0.005	< 0.005	< 0.01
Sodium	NE	21.0	24.0	12.0	26.0
Zinc	1.0	0.85	NA	0.18	0.8
PCB (ppb)	NE	NA	NA	NA	< 0.1

NE - Not established
NA - Not attempted

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Table 4a. Analysis of ground water samples from the IEPA monitoring wells on 10/23/80 in ppm except when noted

PARAMETERS	STANDARDS	G101	G102	G103	G104	G105	G106	G107	G108	G109	G110	G111	G112
Alkalinity	NE	36[illegible]	41[illegible]	336	406	271	36[illegible]	552	375	257	210	302	699
Ammonia	1.5	0.3	1.6	1.7	0.4	0.9	2.9	0.5	0.3	4.5	1.2	0.1	1.5
Arsenic	.05	.023	.023	.043	.049	.067	.16	.043	.008	.055	.053	.008	.019
Barium	1.0	1.3	0.8	2.9	2.2	2.0	0.6	2.1	0.3	0.2	0.5	0.2	0.5
Boron	1.0	0.5	0.4	0.5	0.6	0.4	0.5	0.5	0.4	0.4	0.5	0.5	5.6
Cadmium	.01	0.0	0.0	.03	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	.06
Calcium	NE	180	210	210	210	340	185	500	140	380	500	110	242
C.O.D.	NE	237	160	244	206	473	115	1070	298	275	780	79	162
Chloride	250	48	103	56	52	65	109	13[illegible]	79	69	61	32	363
Chromium (total)	1.05	.04	.02	.09	.04	.12	.01	.07	0.0	0.0	.38	0.0	.01
Chromium (+6)	.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copper	.02	.46	.13	1.1	.31	.73	.44	.68	.04	.13	2.3	.04	1.2
Cyanide	.025	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0
Fluoride	1.4	0.4	0.7	0.7	0.3	1.0	0.7	0.7	0.3	1.2	0.8	0.3	0.5
Hardness	NE	501	884	549	630	528	637	777	496	1664	279	419	1080
Iron	1.0	51.0	39.5	86	89	18	62	13	4.1	39.0	340	5	18
Lead	.05	.19	.15	0.26	0.2	0.31	0.0	0.27	0.0	0.0	7.3	0.07	0.44
Magnesium	NE	69	90	79	72	100	49	205	24	100	209	24	82.5
Manganese	.15	5.1	5.8	4.2	3.4	4.2	1.9	9.8	0.98	4.5	8.8	1.1	3.9
Mercury	.0005	0.0	0.0	.0002	0.0	0.0	0.0	0.0	.0001	0.0	0.0	0.0	.0001
Nickle	1.0	0.1	0.1	0.9	0.1	0.8	0.1	0.3	0.0	0.5	1.9	0.0	0.3
Nitrate-nitrite	10.0	0.1	0.1	0.1	0.4	0.0	0.1	0.1	1.1	0.0	0.4	0.5	0.0
pH	6.5-9.0	6.6	6.6	6.5	6.6	6.6	6.5	6.4	6.6	6.3	6.7	7.0	6.4
Phenolics	.001	0.0	.01	0.0	.005	0.0	.065	2.5	.01	.45	.015	0.0	.875
Phosphorus	.05	2.9	1.2	3.3	2.7	6.0	1.8	9.4	.18	.72	16	.24	.69
Potassium	NE	10.6	13.1	13.4	12.3	22	7.7	15.2	13.7	14.9	29	4.9	58
R.O.E.	500	650	1230	765	790	824	1020	1230	704	2460	508	512	2190
Selenium	.01	.003	.001	.004	.01	.008	.001	.004	.001	.001	.005	.002	.001
Silver	.005	.01	0.0	.02	0.0	0.0	0.0	0.0	.01	0.0	0.0	.02	.11
Sodium	NE	24	60	40	29	57	96	NA	40	40	53	24	260
S.C.	NE	870	1560	1050	1080	1040	1340	1430	960	2470	720	490	NA
Sulfate	250	132	454	230	204	296	281	201	103	1348	93	104	518
Zinc	1.0	0.6	0.4	6.2	0.3	5.7	0.1	0.8	0.0	0.1	9.0	0.0	7.8
PCB (ppb)	NE	1.0	1.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	2.7	< 0.1	< 0.1
Chlorophenol (ppb)	NE	BDL	1200	BDL	BDL	BDL	BDL	630	BDL	19	BDL	BDL	BDL
Chlorobenzene (ppb)	NE	BDL	BDL	BDL	BDL	BDL	BDL	19	BDL	BDL	BDL	BDL	100
Dichlorobenzene (ppb)	NE	BDL	BDL	BDL	BDL	BDL	BDL	25	BDL	BDL	BDL	BDL	65
Dichlorophenol (ppb)	NE	BDL	BDL	BDL	BDL	BDL	BDL	890	BDL	BDL	BDL	BDL	BDL
Cyclohexanone (ppb)	NE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120	5.9	BDL	BDL
Chloroaniline (ppb)	NE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3500

Red indicates above standard amounts NA = Not Attempted NE = Not Established BDL = Below Detection Limit

Table 4b. Analysis of ground water samples from the IEPA monitoring wells on 1/28/81 in ppm except when noted

PARAMETERS	STANDARDS	G101	G102	G103	G104	G105	G106	G107	G108	G109	G110	G111	G112
Alkalinity	NE	447	421	266	520	363	556	621	448	18	308	394	619
Ammonia	1.5	0.3	0.0	1.4	0.2	0.7	3.3	1.0	0.0	17	0.2	0.1	0.5
Arsenic	0.05	0.015	0.016	0.018	0.002	0.037	0.11	0.021	0.004	7.5	0.013	0.014	0.027
Barium	1.0	0.9	1.2	0.9	0.3	1.8	1.0	3.2	0.5	0.2	1.0	0.7	0.5
Boron	1.0	0.3	0.4	0.4	0.7	0.4	0.5	0.5	0.2	0.8	0.2	0.6	0.9
Cadmium	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00
Calcium	NE	220.0	328.9	176.3	218.0	319.2	225.5	1169.5	205.5	466.7	169.4	181.4	198.3
C.O.D.	NE	45	93	56	9	143	212	635	8	1315	37	28	47
Chloride	250	20	128	64	29	59	156	201	76	32	36	18	210
Chromium (total)	1.05	0.02	0.02	0.02	0.00	0.03	0.00	0.09	0.00	0.04	0.02	0.02	0.00
Chromium (+6)	0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	0.02	0.59	0.79	0.36	0.14	0.43	0.29	0.97	0.00	94.1	0.11	0.04	0.28
Cyanide	0.025	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Fluoride	1.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hardness	NE	554	1072	490	717	764	617	960	564	2144	447	530	486
Iron	1.0	30.4	16.5	20.8	1.4	60.8	67.5	172	0.3	198	19.1	10.7	18.9
Lead	0.05	0.17	0.08	0.00	0.00	0.07	0.00	0.32	0.00	0.00	0.00	0.00	0.00
Magnesium	NE	48.2	78.0	46.3	49.1	73.6	49.1	288.1	34.3	184.4	43.5	37.9	54.0
Manganese	0.15	3.02	3.15	3.07	1.41	4.10	2.13	9.64	0.34	8.30	0.77	1.76	2.78
Mercury	.0005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0004	0.0	0.0	0.0
Nichel	1.0	0.1	0.1	0.4	0.0	0.2	0.0	0.5	0.0	176	0.9	0.0	0.0
Nitrate – nitrite	10.0	0.0	2.5	0.1	0.5	0.0	0.0	0.2	3.5	0.3	18	0.5	0.0
pH	6.5 – 9.0	7.0	7.0	7.1	7.2	7.0	6.9	6.9	7.1	4.1	6.9	7.0	6.9
Phenolics	.001	0.0	0.0	0.0	0.0	0.0	1.46	0.5	0.01	1.86	0.02	0.015	0.08
Phosphorous	0.05	0.91	0.88	0.41	0.06	3.6	2.1	10	0.03	3.7	1.0	0.51	0.53
Potassium	NE	6.4	12	8.8	6.0	13	6.2	20	16	18	7.5	4.2	20
R.O.E.	500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.01	0.002	0.002	0.002	0.002	0.003	0.002	0.011	0.004	0.006	0.016	0.002	0.0
Silver	.005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sodium	NE	13	63	48	15	50	94	60	30	37	13	14	18
S.C.	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate	250	129	583	256	265	468	143	276	86	3371	57	153	212
Zinc	1.0	0.3	1.2	1.8	0.1	1.5	0.1	1.5	0.0	10.1	2.0	0.1	2.8
PCB (ppb)	NE	0.22	3.9	NA	0.3	BDL	NA	0.4	BDL	NA	NA	NA	BDL
Chlorobenzene (ppb)	NE	NA	NA	NA	NA	NA	NA	63	BDL	BDL	NA	NA	25
Dichlorophenol (ppb)	NE	NA	NA	NA	NA	NA	NA	560	BDL	BDL	NA	NA	BDL
Chloroaniline (ppb)	NE	NA	NA	NA	NA	NA	NA	90	BDL	BDL	NA	NA	21

Red indicates above standard amounts NA = Not Attempted NE = Not Established BDL = Below Detection Level

Table 3. Because the ground water flow direction is generally east to west, G108 can also be considered a background well. A comparison of the analysis for G108 (Table 4b) with that of G501, G502, G503, and G504 (Table 3) indicates that it indeed is of background quality.

Inorganic chemical parameters analyzed for background quality indicate that iron, manganese, and phosphorus are generally above the State's water quality standards. Organic analysis of these wells showed nothing above the detection limit of 0.1 ppb (Tables 3 and 4b).

In general, results from Table 4a are lower than those found in Table 4b. This is probably due to dilution of samples, which occurred when samples of 4a were collected too soon after drilling and washing of the wells.

Data in Tables 4a and 4b indicates that concentrations of copper, iron, manganese, phosphorus, and R.O.E. exceed the standards and background quality in every well. Lead, phenolics, sulfate and zinc are above the standards in six or more wells.

Among organics analyzed, PCB's were detected in wells G101, G102, and G110. Compared to other wells the relatively high concentrations of 2.7 ppb and 3.9 ppb were found in G110 and G102. Other organics detected such as chlorophenol, chlorobenzene, dichlorobenzene, dichlorophenol, cyclohexanone, and chloroaniline were mostly associated with G107 and G112 even though some other organics were also found in G102, G109, and G110. All these organics are relatively high and not found in the background wells. The organic and inorganic analysis discussed above demonstrate ground water pollution in the area from various sources.

Among the wells, it appears that the ground water in G109 is the most polluted. At G109, ammonia, arsenic, cadmium, copper, iron, manganese, nickel, pH, phenols, phosphorus, R.O.E., sulfate, and zinc exceed the water quality standards by several times. Other parameters for which no standard exists are also in high concentrations. This well is located between Dead Creek and the former disposal impoundment, the exaggerated quantities of ammonia, arsenic, cadmium, copper, nickel, and sulfate must be attributed to this excavation because quantities in other wells directly adjacent to the creek are at least 10 fold less.

Two other wells G112 and G107 exhibit concentrations much above the State Water Quality Standards. One or the other, or both, of the wells show concentrations of barium, boron, copper, iron, lead, manganese, phenols, phosphorus, selenium, sulfate, and zinc above standards. They are also the wells in which organics were detected the strongest. In G107 the two samplings have shown that chlorophenol, chlorobenzene, dichlorobenzene, dichlorophenol, and chloroaniline are present. In G112 chlorobenzene, dichlorobenzene, and chloroaniline have been detected. Since these two wells have these similar characteristics it must be assumed that the pollution source must be common as well. The pollution source is most likely the open dump discussed previously, which lies between the two wells.

Among other highly polluted wells are G110, G106, G105, G103, and G102. Several inorganic parameters are much above the background quality and the standards. Also, some PCB was found in G101 and G102. In G102 chlorophenol was found, and might be explained by its location near the dump which has been suspected of supplying this parameter to wells G107 and G112. Another well, G110, is located between Dead Creek and the believed locations of former sand pits (Figure 4). The only above standard concentration of nitrate (18 ppm) and the highest concentration of selenium (0.016 ppm) are found in this well. The water quality of this well would be affected by the creek and disposal in one of the sand pits if it indeed did occur.

The wells G102, G103, G105, and G106 are located just on the west side of Dead Creek. All exhibit polluted ground water and are probably affected by the creek. However, G106 might also be affected by the open dump to the west of the well.

When compared to the background quality (G108), monitoring wells G101 and G104 indicate very few signs of pollution. This is probably due to the relatively long distance from the pollution sources in the area, and attenuation of the chemicals during the long flow distance and time.

In conclusion, the chemical analyses of ground water from the monitoring wells indicate the pollution of ground water near Dead Creek, the open dump, and the disposal impoundment. It appears that the effects of the pollution have been reduced somewhat near G101 and G104 which are approximately 400 feet to the west of the creek.

Surface Water

The surface waters in the area of Dead Creek which were sampled and analyzed by IEPA personnel include the holding ponds for Cerro Copper, the pond in the former H. H. Hall Construction sand pit, and the creek waters downstream from Judith Lane. Locations for these samples appear on Figure 8 and analysis is on Table 5.

Analysis of H. H. Hall Construction's pond (S501 and S502) indicate that the water is somewhat polluted showing copper, phosphorus, and iron concentrations slightly above the water quality standards. It also shows PCB's present in minor amounts (0.9 ppb and 4.4 ppb).

Analysis of downstream samples S301 and S302 shows that they too have slightly elevated concentrations of copper and phosphorus when compared to standard and again a minor amount of PCB (1.0 ppb) was detected in S301.

On the other hand, the samples taken from Cerro Copper's holding ponds (S503 and S504) show elevated concentrations of copper, iron, lead, mercury, nickel, phosphorus, silver, and zinc. PCB's (22 and 28 ppb) and aliphatic hydrocarbons (23,000 ppb) were also detected, the latter being the only time in the study. As discussed previously, the ponded water here increases the velocity at which infiltration and vertical movement of water takes place. It then must be assumed that these ponds are contributing a large amount of pollution to the ground water but the present placement of monitoring wells at the site cannot determine this.

Plant Analyses

In an attempt to assess the effects which dumping has had on plant matter, IEPA personnel collected beans, bean leaves, corn, and okra from a garden just west of well G102. They were analyzed for PCB with the following results:

Table 5. Analysis of surface water samples, in ppm except where noted

Parameters	Water quality standards	Collection date and well number					
		9/15/80 S501	9/15/80 S502	11/26/80 S503	11/26/80 S504	9/25/80 S301	9/25/80 S302
Alkalinity	NE	80.0	85.0	NA	NA	NA	NA
Ammonia	1.5	0.0	0.0	NA	NA	NA	NA
Arsenic	1.0	0.006	0.01	0.058	0.025	0.008	0.006
Barium	5.0	0.2	0.5	1.2	0.7	0.12	0.08
Berylium	NE	NA	NA	NA	NA	<0.001	<0.001
BOD-5	NE	4.0	33.0	NA	NA	NA	NA
Boron	1.0	0.2	0.2	0.20	0.3	0.06	0.04
Cadmium	0.05	<0.002	<0.002	0.36	0.19	<0.005	<0.005
COD	NE	58.0	85.0	NA	NA	NA	NA
Chloride	500	27.0	28.0	NA	NA	NA	NA
Chromium (total)	1.05	<0.005	<0.005	0.61	0.21	<0.01	0.01
Chromium (+6)	0.05	0.0	0.0	NA	NA	NA	NA
Copper	0.02	0.035	0.33	4.5	3.6	0.26	0.04
Cyanide	0.025	0.02	0.0	NA	NA	NA	NA
Fluoride	1.4	0.4	0.4	NA	NA	NA	NA
Hardness	NE	84.0	94.0	NA	NA	NA	NA
Iron	1.0	0.8	1.8	58.0	28.0	0.66	0.87
Lead	0.1	0.0	0.01	6.6	2.8	<0.05	<0.05
Magnesium	NE	6.0	6.0	35.8	28.7	3.0	2.0
Manganese	1.0	0.06	0.82	1.0	0.67	0.03	0.12
Mercury	0.0005	0.0000	0.0	0.0016	0.0016	NA	NA
Nickel	1.0	0.02	0.05	4.2	3.3	0.05	0.01
Nitrate-Nitrite	NE	0.0	0.0	NA	NA	NA	NA
pH	6.5-9.0	7.4	7.0	NA	NA	NA	NA
Phenols	0.1	0.01	0.01	NA	NA	NA	NA
Phosphorus	0.05	0.17	0.31	1.9	3.4	0.19	0.2
Potassium	NE	5.9	6.2	4.3	6.2	6.6	3.3
R.O.E.	1000	201	217	NA	NA	NA	NA
Selenium	1.0	NA	NA	NA	NA	NA	NA
Silver	0.005	<0.005	<0.005	0.24	0.14	<0.01	<0.01
Sodium	NE	24.0	25.0	19.7	22.4	3.0	3.0
Strontium	NE	NA	NA	NA	NA	0.08	0.07
Sulfate	NE	30.0	28.0	NA	NA	NA	NA
Vanadium	NE	NA	NA	NA	NA	<0.005	<0.005
Zinc	1.0	0.1	0.7	30.0	17.0	0.24	0.06
PCB (ppb)	NE	0.9	4.4	22.0	28.0	1.0	<0.1
Aliphatic hydrocarbons (ppb)	NE	BDL	BDL	23,000	BDL	BDL	BDL

NE - Not established
NA - Not attempted
BDL - Below detection limit

	PCB level (in ppm)
Beans	0.06
Bean leaves	0.13
Corn	0.05
Okra	0.05

Although the Food and Drug Administration has assigned no action level for PCB's in plant matter, it is felt that these values are minute, and do not present any hazard to public health.

RStJ:tk

Summary, Conclusions, and Recommendations

This report is prepared to determine the hydrological framework and possible disposal sites in that part of Dead Creek which lies between New Queeny Avenue and Judith Lane. The potential disposal sites in the area, which have had an impact on ground water, soils, and plants, include: an open dump, a holding pond at Cerro Copper, a former disposal impoundment on the east side of the creek, a pond which exists in H. H. Hall's former sand pit, and 3 sand pits which are now filled.

Twelve monitoring wells drilled adjacent to Dead Creek, and 5 hand auger borings made in the creek, indicate that a 6 to 17 feet thick silt mantle overlies the Henry Formation sands, which are the major aquifer in the area. The creek, which has fill material in it now, at one time had scoured down into the Henry Formation sands. It is clear that soils and ground water in the immediate vicinity of Dead Creek are polluted and that further study is needed for more definitive answers. The ground water quality in the IEPA monitoring wells is probably a result of the above pollution sources combined. These wells show that ground water in the vicinity of the creek has been effected most, and that downgradient wells, some 400 feet away, show little contamination.

The findings and conclusions reached, based on this study, are listed below:

1) The surficial silt mantle is thin and has an average permeability of 5×10^{-6} cm/sec.

2) The Henry Formation sands are a major aquifer and have an average permeability of 4.4×10^{-3} cm/sec.

3) At one time the creek bottom reached, and the sand pits were excavated into the Henry Formation sands.

4) Chemical analysis of soils indicate that surficial soils are primarily polluted at the holding pond in Cerro Copper's plant and in Dead Creek itself.

5) Soil samples from the pond are high in inorganics and organics, including silver, nickel, lead, cadmium, arsenic, copper, manganese, PCB, aliphatic hydrocarbons, and dichlorobenzene.

6) Soil samples from the creek in the study area were high in organics and inorganics. In general, organics were high in the north end, and inorganics in the south end. PCB, dichlorobenzene, xylene, trichlorobenzene, chloronitrobenzene, biphenyl, dichlorophenol, alkylbenzenes, naphthalenes, hydrocarbons, cadmium, cobalt, iron, mercury, zinc, chromate, copper, and phosphorus were in high concentrations. Waste disposal in the creek is the main cause of higher levels of chemicals.

7) PCB and inorganics have migrated to some degree vertically into the Henry Formation sands from the creek bed.

8) When traveling westward, ground water carries away pollutants from the fill in the creek.

9) Surface water from the creek infiltrates downward and carries pollutants into ground water.

10) The holding ponds on Cerro Copper's property, the disposal impoundment, and the open dump are among the major pollution sources of ground water in the area.

11) There has been no tangible evidence to show that former sand pits in the area contribute to any ground water pollution. This does not mean that they don't.

12) Ground water near the creek is polluted. The pollutants include PCB, chlorophenol, chlorobenzene, dichlorobenzene, dichlorophenol, cyclohexanone, chloroaniline, copper, iron, manganese, phosphorus, and R.O.E.

13) Ground water pollution is somewhat reduced at monitoring wells located approximately 400 feet west of the creek.

14) Water from the pond in the Cerro Copper Plant is highly polluted with organics and inorganics.

15) With the present data available, it is difficult to determine the effect which the pond by Judith Lane has on the areas ground water.

Recommendations

1) Ground water pollution sources are many in the area, and further detailed study(ies) is necessary to determine their location, extent and impact on the ground water.

2) Ground water in the study area should not be used for human consumption.

3) Feasibility of removing all wastes and polluted soils from the former disposal impoundment, Cerro Copper's ponds, and the open dump should be studied. If not possible, these areas should have suitable cover material and monitor wells placed on them.

4) The fill material in the creek should be removed and the creek must be filled with a clayey soil later. If this is not possible, the present creek topography must be filled to the ground level with a clayey soil.

5) Taking the above recommendations into consideration, a plan might also be developed to install a system of monitor wells for ground water quality analysis in the area. This could aid local well drillers and public officials to insure public safety.

6) Plans for the construction of New Queeny Avenue should be secured to determine the depth of former sand pits in the area.

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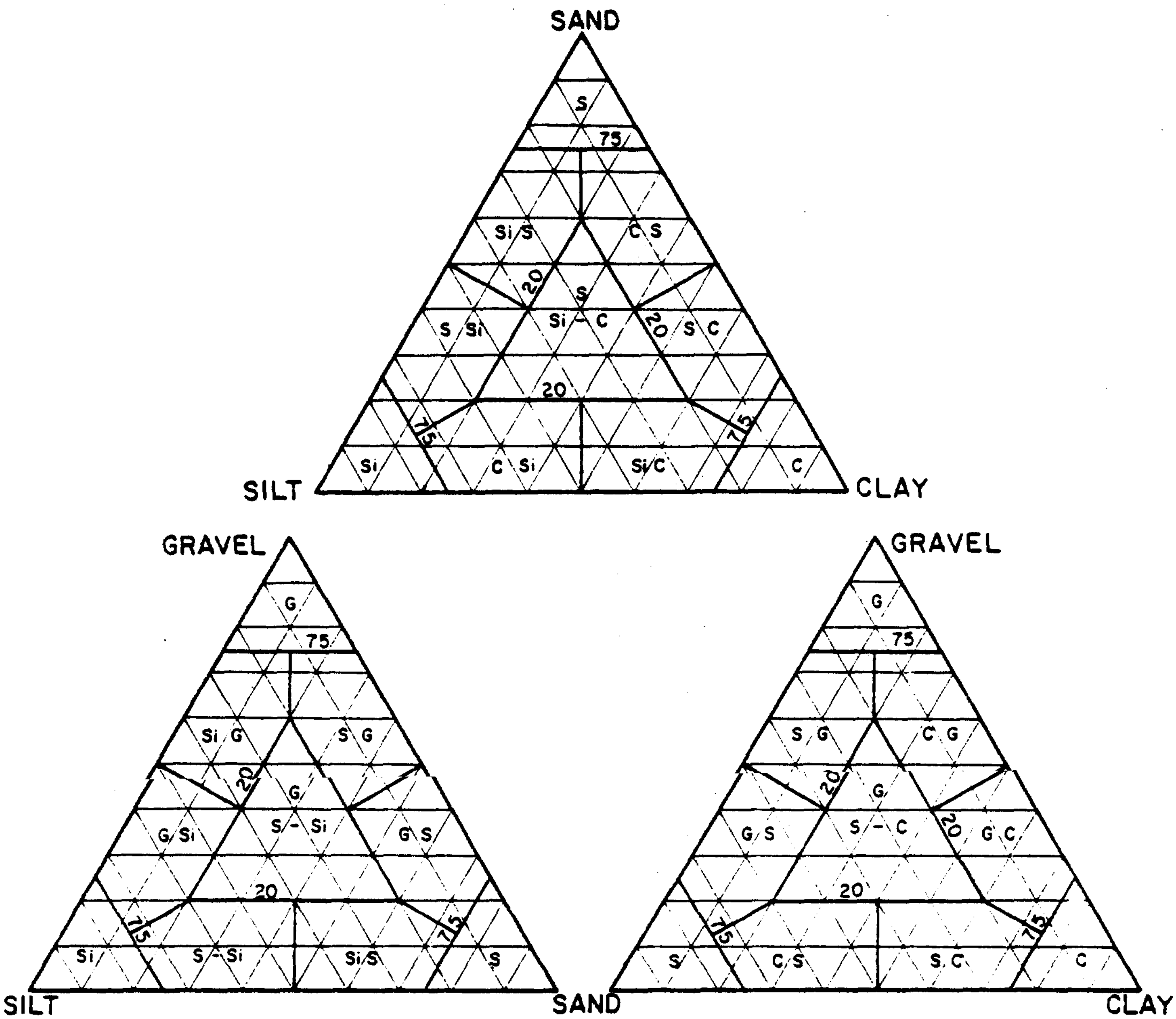
Appendix 1 - Boring Logs



Percent grain size	Adjective modifiers for minor grain sizes*
not included in major classification	w/ some
< 5%	trace

*Only applicable to wells bored by the IEPA

Figure A-1. Textural triangles (adopted from Shepard, 1954) and terminology used for classification of unconsolidated deposits.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 1 SH.

COUNTY St. Clair SITE NO ____ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/8/80 BORING NO B-1 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-101)

TYPE AND LENGTH OF CASING PVC 29.5 FT CASING 1.0 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 371.32 to 391.32 (20 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cutting
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 390.32
AFTER 2 DAYS 393.92
AFTER 14 DAYS 393.22

Description	Elevation	Depth	#	•	N
		+3			
GROUND SURFACE	399.82	0			
Clayey Silt (topsoil) Dark brown to gray			1	M	
organics				D	
		5			
			2	M	
Silt Brown micaceous	392.15		3	W	
	389.82	10			
Sand (arenitic) Tan very fine grained, moderately sorted, rounded, containing ferro-magnesian minerals.			4	W	
			5	W	
	384.82	15			
Sand (arkosic) Tan fine to coarse grained, moderately rounded, containing ferro-magnesian minerals				W	
		20			
very poorly sorted			6	W	
		25			
w/some rounded medium grained gravel			7	W	
		30			
	367.82			W	
Boring completed					

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

• Miscellaneous Data PR - Partial Recovery
N - Blow Count NR - No Recovery

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LPC-34 3/73

recycled paper
recycled paper

ecology and environment
ecology and environment

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 2 SH.

COUNTY St. Clair SITE NO ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/8/80 BORING NO B-2 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ______ WHICH Monitor (G-102)

TYPE AND LENGTH OF CASING PVC 34.0 FT CASING 1.2 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 375.59 to 400.59 (25 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 393.39
AFTER 2 DAYS 394.09
AFTER 14 DAYS 393.89

Description	Elevation	#	*	N
	+3			
GROUND SURFACE 408.39	0			
Clayey Silt, Tan to brown, organics		1	D	3' Spn.
Silt, Light tan, micaceous throughout		2	D	5/5
	-5	3	D	6/6
Sandy Silt, Light gray		4	D	4/5
Gray, organics	-10	5	M	2/2
395.39				
Sand (arkosic), Gray, fine grained, moderately sorted		6	M	5/5
	-15			

Description	Elevation	#	*	N
Sand (arkosic), Tan, fine grained, moderately sorted		7	W	4/6
		8	W	4/8
Gray, coarse grained, poorly sorted lenses	-20	9	W	5/6
	-25			
fine to medium grained		10	W	5/3
coal & wood chips throughout	-30			5/4

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery
N - Blow Count — NR - No Recovery

LPC-34 3/79

BORING LOG

St. Clair County
Dead Creek/Cahokia
B-2 (G-102)

	ELEVATION	#	•	N	WELL DESIGN
Sand (arkosic) Gray fine to medium grained, poorly sorted, contains coal & wood chips throughout 371.89	-35		NR	17/14	
Boring completed	-40				
	-45				
	-50				
	-55				
	-60				

ELEVATION	#	•	N	WELL DESIGN
-65				
-70				
-75				
-80				
-85				
-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG

COUNTY St.Clair SITE NO. ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/9/80 BORING NO. B-3 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ______ WHICH Monitor (G-103)

TYPE AND LENGTH OF CASING PVC 35.5 FT CASING 2.7 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 375.30 to 401.90 (26.6 feet slotted)

ANNULUS FILL MATERIAL

ABOVE PACKING Cuttings

PACKING Bentonite

SCREEN 3/8" Gravel

GROUND WATER EL.

AT COMPLETION 393.10

AFTER 1 DAYS 394.1

AFTER 13 DAYS 394.4

Description	Elevation	#	*	N
	+3			
GROUND SURFACE 408.10	0			
Clayey Silt (topsoil) Brown w/some sand		1	D	
Silt Light tan micaceous			D	4/4
Clayey Silt w/some sand oxidation	-5	2	D	5/4
Sandy Silt Tan to gray w/some clay micaceous throughout		3	D	2/2
Clayey Silt Gray 396.85	-10	4	M	2/2
Sand (arkosic) Tan very fine grained		5	W	4/5
	-15			

Description	Elevation	#	*	N
Sand (arkosic) w/some silt Tan fine grained		6	W	5/7
w/some silt	-20	7	W	6/9
fine to medium grained, moderately sorted, subrounded	-25	8	W	5/7
w/some gravel fine to coarse grained, poorly sorted w/black petroleum smelling substance	-30	9/10	W	9/17

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery

N - Blow Count NR - No Recovery

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St. Clair
Dead Creek/Cahokia
B-3 (G-103)

Description	ELEVATION	#	•	N	WELL DESIGN
Sand (arkosic) Tan medium to coarse grained, poorly sorted, subangular w/wood chips & peculiar smell	-35	11	W	8/15	
371.60					
Boring complete	-40				
	-45				
	-50				
	-55				
	-60				

	ELEVATION	#	•	N	WELL DESIGN
	-65				
	-70				
	-75				
	-80				
	-85				
	-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 2 SH.

COUNTY St. Clair — SITE NO. ____ — PREPARED BY Ron St. John

SITE Dead Creek/Cahokia — BORED BY Ken Bosie

DATE 10/9/80 — BORING NO B-4 — HELPER Ron St. John

BORING COMPLETED AS MONITOR OR LEACHATE WELL — YES X — NO ____ — WHICH Monitor (G-104)

TYPE AND LENGTH OF CASING PVC 37.4 FT — CASING 3.4 FT. ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 375.3 to 400.3 (25 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 392.80
AFTER 1 DAYS 393.4
AFTER 14 DAYS 393.6

Description	Elevation	#	*	N
	+3			
GROUND SURFACE 409.30	0			
Silty Sand (topsoil) Light tan w/some clay throughout		1	D	
Sandy Silt micaceous		2	D	3/5
2" clay lense 402.30	-5	3	M	4/5
Silty Sand Light tan micaceous Brown & gray 397.30		4	M	4/5
Sand (arkosic) Tan fine to medium grained 394.80	-10	5	M	5/4
Clay Gray oxidation		6	W	5/4
	-15			
Clay Gray oxidation 392.80		7	W	2/6
Sand (arkosic) Tan to brown fine to medium grained		8	W	8/8
	-20		W	3/5
	-25	9	W	5/8
fine to coarse grained, poorly sorted, subrounded w/gravel	-30	10	W	3/9

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery
N - Blow Count — NR - No Recovery

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BORING LOG

St. Clair County
Dead Creek/Cahokia
B-4 (G-104)

	ELEVATION	#	•	N	WELL DESIGN
Sand Tan & brown fine to coarse grained, poorly sorted, subrounded w/occasional gravel 372.80	-35				
Boring complete	-40				
	-45				
	-50				
	-55				
	-60				

ELEVATION	#	•	N	WELL DESIGN
-65				
-70				
-75				
-80				
-85				
-90				

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 2 SH.

COUNTY St. Clair SITE NO. ____ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/10/80 BORING NO B-5 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-105)

TYPE AND LENGTH OF CASING PVC 37.1 FT CASING 2.6 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 372.81 to 397.81 (25 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 392.31
AFTER 6 DAYS 394.61
AFTER 13 DAYS 394.51

GROUND SURFACE 407.31

Description	Elevation	*	•	N
	+3			
GROUND SURFACE 407.31	0			
Silt (topsoil) Brown		1	D	3' Spn.
Tan		2	D	4/4
Brown organics	-5		D	4/3
Brown to gray intermittent sand, silt & clay micaceous & oxidation throughout		3	M	2/2
Silty Sand	-10	4	M	2/1
Gray to brown 2" clay lense @ 13 ft.		5	M	3/1
	-15			

Description	Elevation	*	•	N
Sand Brown very fine grained micaceous		6	W	4/4
390.31		7		5/7
Sand (arkosic) Gray micaceous	-20	8		5/5
Brown				
	-25			
Tan fine to medium grained gravel throughout		9		7/6
medium grained w/gravel	-30	10		5/5

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data
N - Blow Count
PR - Partial Recovery
NR - No Recovery

LPC-34 3/79

BORING LOG

St. Clair County Dead Creek/Cahokia B-5 (G-105)	ELEVATION	#	•	N	WELL DESIGN		ELEVATION	#	•	N	WELL DESIGN
Sand & Gravel (arkosic) Gray medium grained sand & fine grained gravel	-35	11	W	5/6			-65				
370.81											
Boring complete	-40						-70				
	-45						-75				
	-50						-80				
	-55						-85				
	-60						-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 2 SH.

COUNTY St. Clair SITE NO. ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/15/80 BORING NO B-6 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-106)

TYPE AND LENGTH OF CASING PVC 42.4 FT CASING 2.4 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 366.67 to 401.67 (35 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 390.67
AFTER 1 DAYS 394.07
AFTER 7 DAYS 394.17

Description	Elevation	#	•	N
	+3			
GROUND SURFACE 406.67	0			
Gravel & asphalt Brown to black w/silty topsoil throughout			D	3' Spn.
			D	2/3
402.17				
Silt Light tan micaceous	-5		D	3/2
Tan to black (strong chemical odor)		1	M	3/2
Gray to black	-10	2	M	2/1
395.17				
Silty Sand Gray to black (chemical odor)		3	M	5/5
	-15			

Description	Elevation	#	•	N
Sand Black (strong chemical color & odor)		4	W	1/6
		5	W	5/6
387.17				
Sand (arkosic) Gray fine to medium grained subangular, poorly sorted, chemical odor	-20	6	W	3/2
	-25			2/3
chemical colored hues	-30	7	W	5/11

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery
N - Blow Count NR - No Recovery

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BORING LOG

St. Clair County Dead Creek/Cahokia B-6 (G-106)	ELEVATION	#	•	N	WELL DESIGN
Sand & Gravel Gray coarse grained w/wood & coal fragments throughout	-35			8/10	
	-40	NR			
365.17					
Boring complete	-45				
	-50				
	-55				
	-60				

ELEVATION	#	•	N	WELL DESIGN
-65				
-70				
-75				
-80				
-85				
-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 2 SH.

COUNTY St. Clair SITE NO ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/16/80 BORING NO B-7 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-107)

TYPE AND LENGTH OF CASING PVC 35.1 FT CASING 1.3 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 367.05 to 397.05

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 391.35
AFTER 6 DAYS 390.05
AFTER 15 DAYS 393.65

Description	Elevation	#	•	N
	+3			
GROUND SURFACE 400.85	0			
Silt (topsoil) Brown		1	D	
Brown to light tan micaceous throughout intermittent clay, silt & sand			D	6/7
	-5			
		2	M	3/3
Silty Sand Tan oxidation		3	M	3/3
391.35 ▼	-10			
Sand (arkosic) Tan fine grained (containing chemical hues)		4	W	3/3
	-15			
Sand (arkosic) Gray to black fine grained micaceous (observably polluted)		5	W	3/5
		6	W	6/8
	-20			
Gray fine to medium grained		7	W	6/9
	-25			
		8	W	5/10
	-30			
		9	W	7/8

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data
N - Blow Count
PR - Partial Recovery
NR - No Recovery

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BORING LOG

St.Clair County Dead Creek/Cahokia B-7 (G-107)	ELEVATION	#	•	N	WELL DESIGN		ELEVATION	#	•	N	WELL DESIGN
Sand (arkosic) Gray fine to medium grained, subangular w/gravel 364.35	-35										
							-65				
Boring complete	-40										
							-70				
	-45										
							-75				
	-50										
							-80				
	-55										
							-85				
	-60										
							-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG

COUNTY St.Clair SITE NO

PREPARED BY Ron St. John

SITE Dead Creek/Cahokia

BORED BY Doug Tolan

DATE 10/20/80 BORING NO B-8

HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO WHICH Monitor (G-108)

TYPE AND LENGTH OF CASING PVC 36.4 FT

CASING 2.2 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 372.56 to 402.56

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 394.76
AFTER 3 DAYS 395.06
AFTER 11 DAYS 394.16

Description	Elevation	#	•	N
	+3			
GROUND SURFACE 406.76	0			
Silty Clay (topsoil) Brown		1	D	
Silty Sand Tan micaceous w/some clay throughout		2	D	4/4
	-5			
Sandy Silt 400.76		3	M	5/7
Sand (arkosic) Tan fine grained		4	M	4/4
	-10			
fine to medium grained		5	M	5/4
(polluted smell)	▼			
augered through to 35 feet		6	W	6/5
	-15			

Description	Elevation	#	•	N
augered through to 35 feet, cuttings indicated sand coarsening with depth				
	-20			
	-25			
	-30			

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

• Miscellaneous Data
N - Blow Count
PR - Partial Recovery
NR - No Recovery

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St. Clair County Dead Creek/Cahokia B-8 (G-108)	ELEVATION	#	•	N	WELL DESIGN		ELEVATION	#	•	N	WELL DESIGN
augered through to 35 feet 371.76	-35										
Boring complete							-65				
	-40						-70				
	-45						-75				
	-50						-80				
	-55						-85				
	-60						-90				

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 2 SH.

COUNTY St. Clair SITE NO ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/21/80 BORING NO B-9 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-109)

TYPE AND LENGTH OF CASING PVC 38.5 FT CASING 3.5 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 370.68 to 397.68 (27 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 392.18
AFTER 2 DAYS 394.38
AFTER 10 DAYS 394.98

Description	Elevation	#	•	N
	+3			
GROUND SURFACE 407.18	0			
Silt (topsoil) Brown to light tan		1	D	
Light tan micaceous & oxidation		2	D	5/4
	-5	3	D	6/4
Clayey Silt Tan to gray micaceous 398.68		4	D	4/6
Sand Gray very fine grained (chemical smell)	-10	5	M	12/9
395.18				
Sand (arkosic) Gray very fine grained (strong chemical odor)		6	M	11/14
	-15			

Description	Elevation	#	•	N
Sand (sludge) Black 2" metallic zone		7a 7b	W	11/9
		8 PCB	W	5/6
	-20	9	W	10/10
		10	W	8/10
		11	W	4/7
	-25			
fine to medium grained w/gravel		12	W	6/7
	-30	13	W	4/9

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery
N - Blow Count NR - No Recovery

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BORING LOG

St. Clair County Dead Creek/Cahokia B-9 (G-109)	ELEVATION	*	•	N	WELL DESIGN
Sand **Black** **fine to coarse grained w/fine grained gravel (polluted)** 370.68	-35		NR	8/13	
Boring complete	-40				
	-45				
	-50				
	-55				
	-60				

	ELEVATION	*	•	N	WELL DESIGN
	-65				
	-70				
	-75				
	-80				
	-85				
	-90				

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 1 SH.

COUNTY St. Clair SITE NO. ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/22/80 BORING NO B-10 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES X NO ____ WHICH Monitor (G-110)

TYPE AND LENGTH OF CASING PVC 31.3 FT CASING 1.3 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 377.14 to 402.14 (25 feet slotted)

ANNULUS FILL MATERIAL

ABOVE PACKING Cutting

PACKING Bentonite

SCREEN 3/8" Gravel

GROUND WATER EL.

AT COMPLETION 395.14

AFTER 1 DAYS 394.74

AFTER 9 DAYS 394.34

Description	Elevation	#	*	N
	+3			
GROUND SURFACE 407.14	0			
Sandy Silt (topsoil) Brown to light tan		1	D	
Tan w/gravel throughout (disturbed)		2	D	3/2
403.14	-5			
Sandy Silt Brown to gray micaceous		3	D	4/3
Tan to gray intermittent clayey, sand & silt		4	M	2/2
	-10			
		5	M	5/5
Gray to tan oxidation 395.14 ▼				
Silty Sand (arkosic) Tan fine grained micaceous		6	W	8/6
392.14	-15			

Description	Elevation	#	*	N
Sand (arkosic) Tan fine grained		7	W	4/6
		8	W	5/4
	-20			
		9	W	5/4
Gray fine to medium grained				
		10	W	2/8
	-25			
	-30			
Gray to tan		11	W	4/6
medium to coarse grained 375.64				
Boring complete				

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery

N - Blow Count NR - No Recovery

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH 1 of 2 SH.

COUNTY St. Clair — SITE NO ______ — PREPARED BY Ron St. John

SITE Dead Creek/Cahokia — BORED BY Doug Tolan

DATE 10/23/80 — BORING NO B-11 — HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL — YES X — NO ____ — WHICH Monitor (G-111)

TYPE AND LENGTH OF CASING PVC 35.5 FT — CASING 1.5 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 374.41 to 396.41 (22 feet slotted)

ANNULUS FILL MATERIAL
ABOVE PACKING Cuttings
PACKING Bentonite
SCREEN 3/8" Gravel

GROUND WATER EL.
AT COMPLETION 391.91
AFTER 7 DAYS 394.21
AFTER 8 DAYS 393.91

GROUND SURFACE 408.41

Description	Elevation	#	•	N
	+3			
GROUND SURFACE 408.41	0			
Sandy Silt (topsoil) Brown to tan micaceous throughout		1	D	
Light tan		2	D	4/4
	-5			
		3	D	4/4
Light tan to gray clay lenses		4	D	3/3
	-10			
Gray to tan intermittent clay, silt & sand		5	M	3/3
		6	M	3/1
	-15			

Description	Elevation	#	•	N
Clayey Silt Gray micaceous		7	W	1/1
391.91				
Sand (arkosic) Tan fine grained micaceous		8	W	3/4
	-20			
		9	W	4/4
	-25			
fine to medium grained w/fine grained gravel		10	W	5/5
	-30			
Sand & Gravel (arkosic) Tan fine to coarse grained subangular to angular		11	W	7/11

All Samples Taken with 2 Inch O D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery

N - Blow Count — NR - No Recovery

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St. Clair County
Dead Creek/Cahokia
B-11 (G-111)

Description	ELEVATION	#	•	N	WELL DESIGN
Sand & Gravel (arkosic) Tan medium to coarse grained sand & fine to coarse grained gravel 371.91	-35	12	W	12/14	
Boring complete	-40				
	-45				
	-50				
	-55				
	-60				

ELEVATION	#	•	N	WELL DESIGN
-65				
-70				
-75				
-80				
-85				
-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 2 SH.

COUNTY St. Clair — SITE NO ______ — PREPARED BY Ron St. John

SITE Dead Creek/Cahokia — BORED BY Doug Tolan

DATE 10/29/80 — BORING NO B-12 — HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL — YES X — NO ______ — WHICH Monitor (G-112)

TYPE AND LENGTH OF CASING PVC 37.8 FT — CASING 2.7 FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS 372.62 to 394.62 (22 feet slotted)

ANNULUS FILL MATERIAL

ABOVE PACKING Cutting

PACKING Bentonite

SCREEN 3/8" Gravel

GROUND WATER EL.

AT COMPLETION 396.72

AFTER 12 DAYS 394.12

AFTER ______ DAYS ______

Description	Elevation	#	•	N
GROUND SURFACE 407.72	+3 / 0			
Fill Black asphaltic (disturbed)	-5	1	M	
400.72				
Clay w/Silt Gray poorly indurated organics		2	M	5/5
396.47	-10	3	M	2/4
Silt Gray micaceous		4	W	2/2
	-15			

Description	Elevation	#	•	N
Silt Gray micaceous		5	W	2/7
390.72				
Sand (arkosic) Gray fine grained w/silt throughout		6	W	5/4
Tan	-20	7	W	4/5
Gray fine to medium grained	-25	8	W	6/7
fine to coarse grained	-30	9	W	10/13

All Samples Taken with 2 inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery

N - Blow Count — NR - No Recovery

LPC-34 3/79

BORING LOG

St. Clair County Dead Creek/Cahokia B-12 (G-112)	ELEVATION	#	•	N	WELL DESIGN
Sand & Gravel (arkosic) Gray fine to coarse grained	-35	10	W	16/22	
371.22					
Boring complete	-40				
	-45				
	-50				
	-55				
	-60				

ELEVATION	#	•	N	WELL DESIGN
-65				
-70				
-75				
-80				
-85				
-90				

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 1 SH.

COUNTY St. Clair SITE NO. ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/30/80 BORING NO. P-1 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES ____ NO X WHICH ____

TYPE AND LENGTH OF CASING ______ FT CASING ______ FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS ______

ANNULUS FILL MATERIAL

ABOVE PACKING ______

PACKING ______

SCREEN ______

GROUND WATER EL.

AT COMPLETION ______

AFTER ______ DAYS ______

AFTER ______ DAYS ______

Description	Elevation	#	•	N	Well Design
	+3				
GROUND SURFACE 401.03	0				
Silt Discolored chemical odor 400.03		1			
		2			
Clayey Silt Black chemical odor (strong @ 2 feet)		3			
		4			
398.03	-5	5			
Silt Gray (wore mask)		6			
395.03		7			
Clayey Sandy Silt Gray		8			
393.03			NR		
Sand 392.03	-10				
Boring complete					
	-15				

Right-hand elevation scale: -20, -25, -30

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery

N - Blow Count NR - No Recovery

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 1 SH.

COUNTY St. Clair SITE NO ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/30/80 BORING NO P-2 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES ____ NO X WHICH ______

TYPE AND LENGTH OF CASING ______ . ______ FT CASING ______ FT. ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS ______

ANNULUS FILL MATERIAL

ABOVE PACKING ______

PACKING ______

SCREEN ______

GROUND WATER EL.

AT COMPLETION ______

AFTER ______ DAYS ______

AFTER ______ DAYS ______

Description	Elevation	ELEVATION	#	•	N	WELL DESIGN
		+3				
GROUND SURFACE	399.70	0				
Clayey Silt Gray						
		-5				
Sand (arkosic) Tan fine grained	391.70					
Boring complete	390.70	-10				
		-15				

ELEVATION	#	•	N	WELL DESIGN
-20				
-25				
-30				

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data PR - Partial Recovery

N - Blow Count NR - No Recovery

70

LPC-34 3/79

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ecology and environment

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 1 SH.

COUNTY St. Clair SITE NO. ____ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/30/80 BORING NO P-3 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES ____ NO X WHICH ____

TYPE AND LENGTH OF CASING ____ ____ FT CASING ____ FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS ____

ANNULUS FILL MATERIAL

ABOVE PACKING ____

PACKING ____

SCREEN ____

GROUND WATER EL.

AT COMPLETION ____

AFTER ____ DAYS ____

AFTER ____ DAYS ____

Description	Elevation	Depth (ELEVATION)	#	•	N	WELL DESIGN
		+3				
GROUND SURFACE	400.67	0				
Silt Black, orange & green	399.67		1, 2			
Clayey Silt Gray chemical odor	395.67		3, 4			
Silt Gray micaceous	394.67	-5	5, 6			
Clayey Silt Gray micaceous	393.17		7, 8			
Sand (arkosic) Gray fine grained	392.67	-10				
Boring complete		-15				

Right-hand elevation scale: -20, -25, -30

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery

N - Blow Count — NR - No Recovery

LPC-34 3/79

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG SH. 1 of 1 SH.

COUNTY St. Clair SITE NO. ______ PREPARED BY Ron St. John

SITE Dead Creek/Cahokia BORED BY Doug Tolan

DATE 10/30/80 BORING NO. P-4 HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL YES ______ NO X WHICH ______

TYPE AND LENGTH OF CASING ______ . ______ FT CASING ______ FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS ______

ANNULUS FILL MATERIAL

ABOVE PACKING ______

PACKING ______

SCREEN ______

GROUND WATER EL.

AT COMPLETION ______

AFTER ______ DAYS ______

AFTER ______ DAYS ______

Description	Elevation	#	•	N	Well Design
	+3				
GROUND SURFACE 399.72	0				
Sandy, Clayey, Silt Discolored 398.72		1			
Clayey Silt Gray to black oxidation 397.72		2			
		3			
Silty Clay Gray oxidation 396.72		4			
	-5	5			
Clayey Silt Gray oxidation 395.72		6			
		7			
Clayey, Sandy, Silt Gray 393.72		8			
Silty Clay Gray 392.72	-10				
Sand (arkosic) Gray fine grained 391.22					
Boring complete					
	-15				

Elevation scale (right): -20, -25, -30

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

• Miscellaneous Data PR - Partial Recovery

N - Blow Count NR - No Recovery

72

LPC-34 3/79

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DIVISION OF LAND/NOISE POLLUTION CONTROL

BORING LOG — SH. 1 of 1 SH.

COUNTY St. Clair — SITE NO ______ — PREPARED BY Ron St. John

SITE Dead Creek/Cahokia — BORED BY Doug Tolan

DATE 10/30/80 — BORING NO P-5 — HELPER Ken Bosie

BORING COMPLETED AS MONITOR OR LEACHATE WELL — YES ____ NO X WHICH ____

TYPE AND LENGTH OF CASING ______ ______ FT — CASING ______ FT ABOVE GROUND LEVEL

SCREENED INTERVAL ELEVATIONS ______

ANNULUS FILL MATERIAL
ABOVE PACKING ______
PACKING ______
SCREEN ______

GROUND WATER EL.
AT COMPLETION ______
AFTER ______ DAYS ______
AFTER ______ DAYS ______

Description	Elevation	#	*	N	Well Design
GROUND SURFACE 399.65	0				
Silt — Orange, black & gray — 398.65		1			
Clayey Silt — Gray, oxidation — 397.65		2, 3			
Silty Clay — Gray, organics & oxidation — 396.65	▼ -5	4, 5			
Silt — Gray, micaceous & clay lenses — 394.65		6, 7			
Clayey Silt — Gray to black — 393.65		8, 9			
Silt — Gray to black, micaceous — 389.85	-10				
Sand (arkosic) — Gray, fine grained — 389.65					
Boring complete	-15				

Elevation scale: +3, 0, -5, -10, -15 (left); -20, -25, -30 (right)

All Samples Taken with 2 Inch O.D. Split Spoon Sampler Unless Otherwise Indicated

* Miscellaneous Data — PR - Partial Recovery
N - Blow Count — NR - No Recovery

LPC-34 3/79

Appendix 2 - Grain Size and Permeability Analysis

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ecology and environment

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______

Date Collected 10/9/80

Division Program Code ______

Laboratory ID No. B 24219

Date Received Nov.14.1980

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-3, S-1,0-2.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
X DISTURBED PERMEABILITY
__ OTHER ______

DATE ANALYSIS COMPLETED ______

DATE ANAYSIS REPORTED ______

TEST RESULTS

permeability:

4.5×10^{-6} cm/sec

grain size:

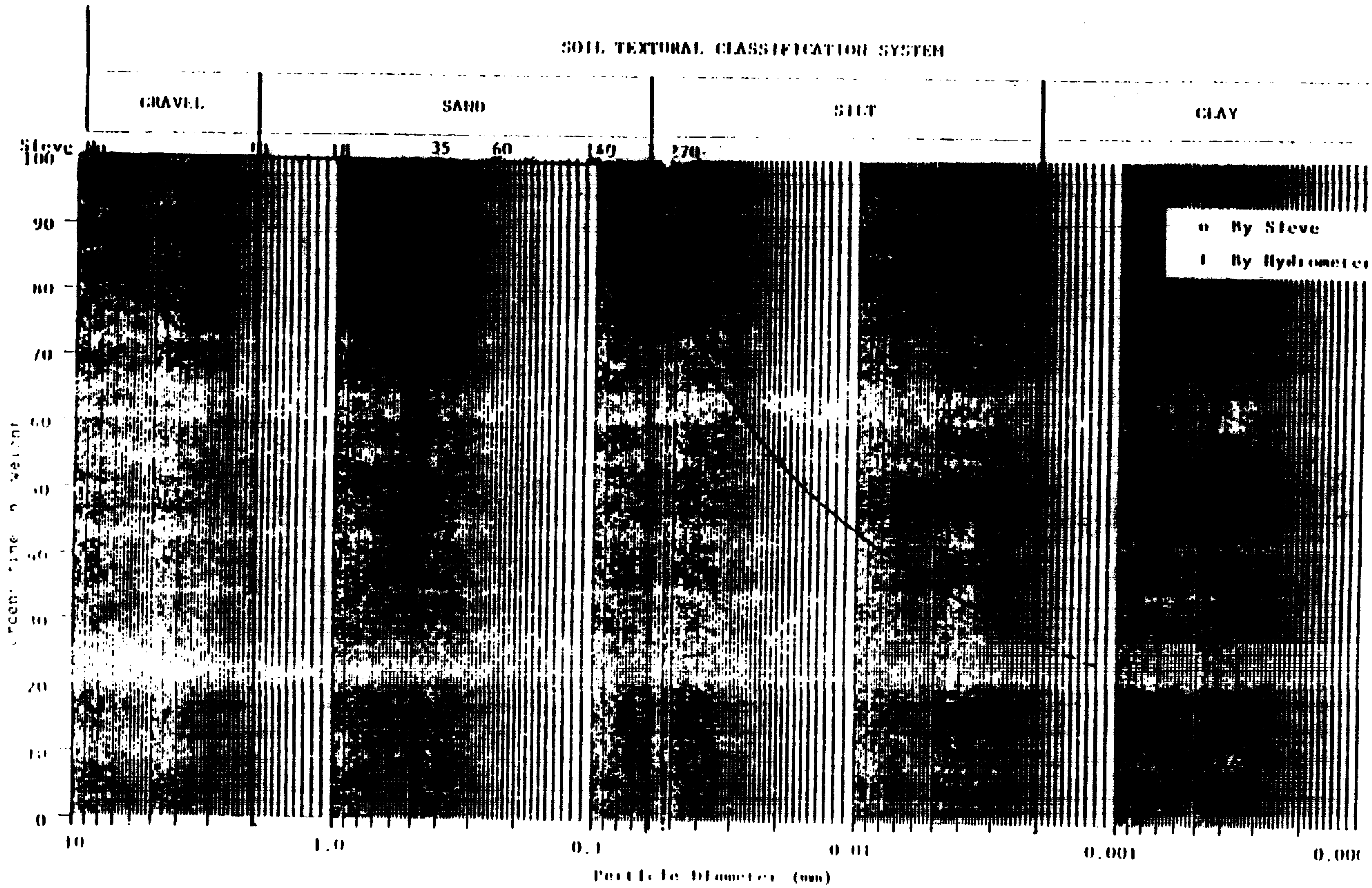
sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.96	5.0	.0182	55.00
18	1.00	99.90	20.0	.0098	43.41
35	.417	99.84	60.0	.0055	37.53
60	.250	99.59	240.	.0025	29.91
140	.105	98.49	360.	.0022	23.95
270	.053	87.38			
pan					

COMMENTS

recycled paper

75

recycled paper



Sample No. (Field) ____________ Sample No. (Lab.) ____ Date ____________

Illinois Environmental Protection Agency --DLS Tested By ________

% Gravel .04 % Sand 7.0 % Silt 64.03 % Clay 28.95 Name: Clayey Silt, w/some sand

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24220

Date Collected 10/9/80 Date Received Nov. 14, 1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-3, S-2, 5.0-6.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS

X SIEVE SIZE ANALYSIS

UNDISTURBED PERMEABILITY

X DISTURBED PERMEABILITY

OTHER ______________

DATE ANALYSIS COMPLETED ________

DATE ANAYSIS REPORTED ________

TEST RESULTS

permeablilty: 9.8×10^{-6} cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0	.0170	45.30
18	1.00	99.98	20.0	.0092	36.00
35	.417	99.89	60.0	.0051	26.71
60	.250	99.80	240.	.0024	22.07
140	.105	99.31	360.	.0019	22.07
270	.053	87.02			
pan					

COMMENTS

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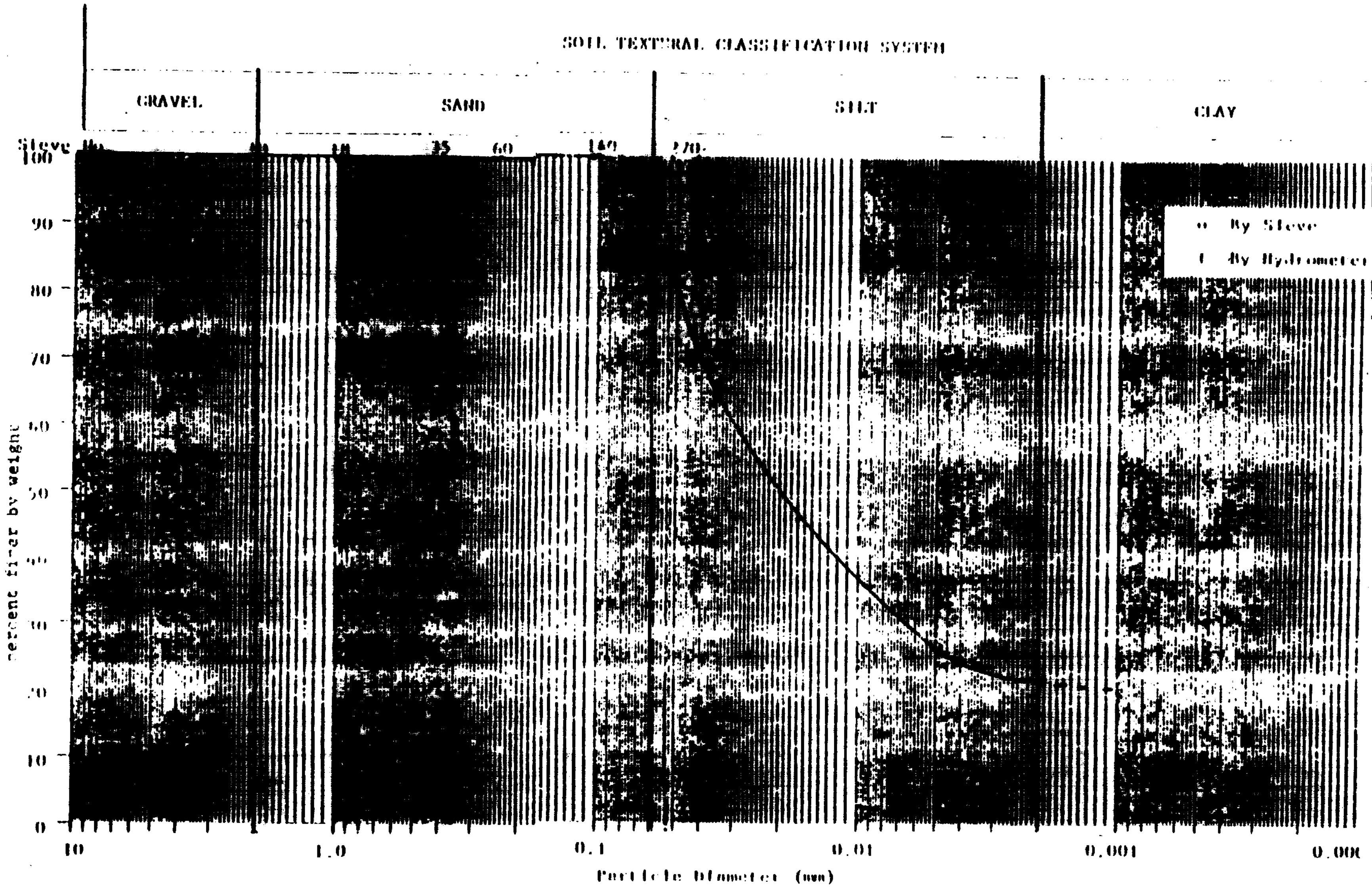
LPC 26 7/80



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Illinois Environmental Protection Agency---DLS Tested By ______

% Gravel 0 % Sand 7.0 % Silt 70.93 % Clay 22.07 Name: Clayey Silt, w/some sand

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________

Laboratory ID No. B 24221

Date Collected 10/9/80

Date Received Nov. 14, 1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-3, S-3, 7.5-9.0

Physical Observations, Remarks

TESTS REQUESTED

x HYDROMETER SIZE ANALYSIS
x SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
X DISTURBED PERMEABILITY
__ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability: 5.4×10^{-3} cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D (mm)	P, % remaining in solution
10	2.00	100.00	5.0	.0186	34.49
18	1.00	100.00	20.0	.0088	22.32
35	.417	99.94	60.0	.0050	18.26
60	.250	99.89	240.	.0025	16.13
140	.105	99.11	360.	.0020	15.21
270	.053	77.74			
pan					

COMMENTS

recycled paper

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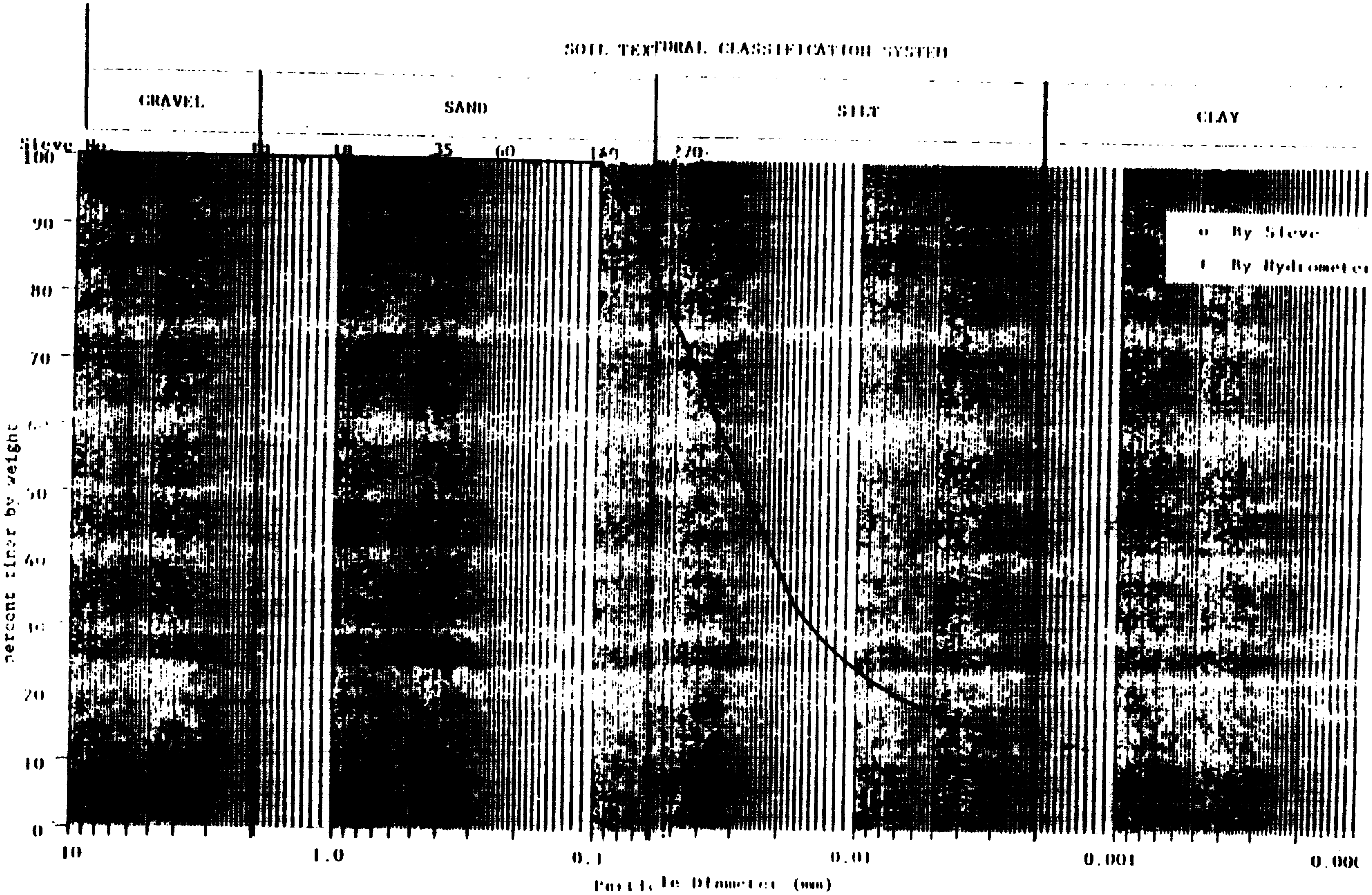
recycled paper

ecology and environment LPC 20 7 39



Sample No. (Field) ________ Sample No. (Lab.) ________ Date ________

Illinois Environmental Protection Agency---DLS Tested By ________

% Gravel 0 % Sand 18 % Silt 66.79 % Clay 15.21 Name: Sandy Silt w/some clay

V-781

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24222

Date Collected 10/9/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-3, S-4, 10.0-11.5

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ________

DATE ANAYSIS REPORTED ________

TEST RESULTS

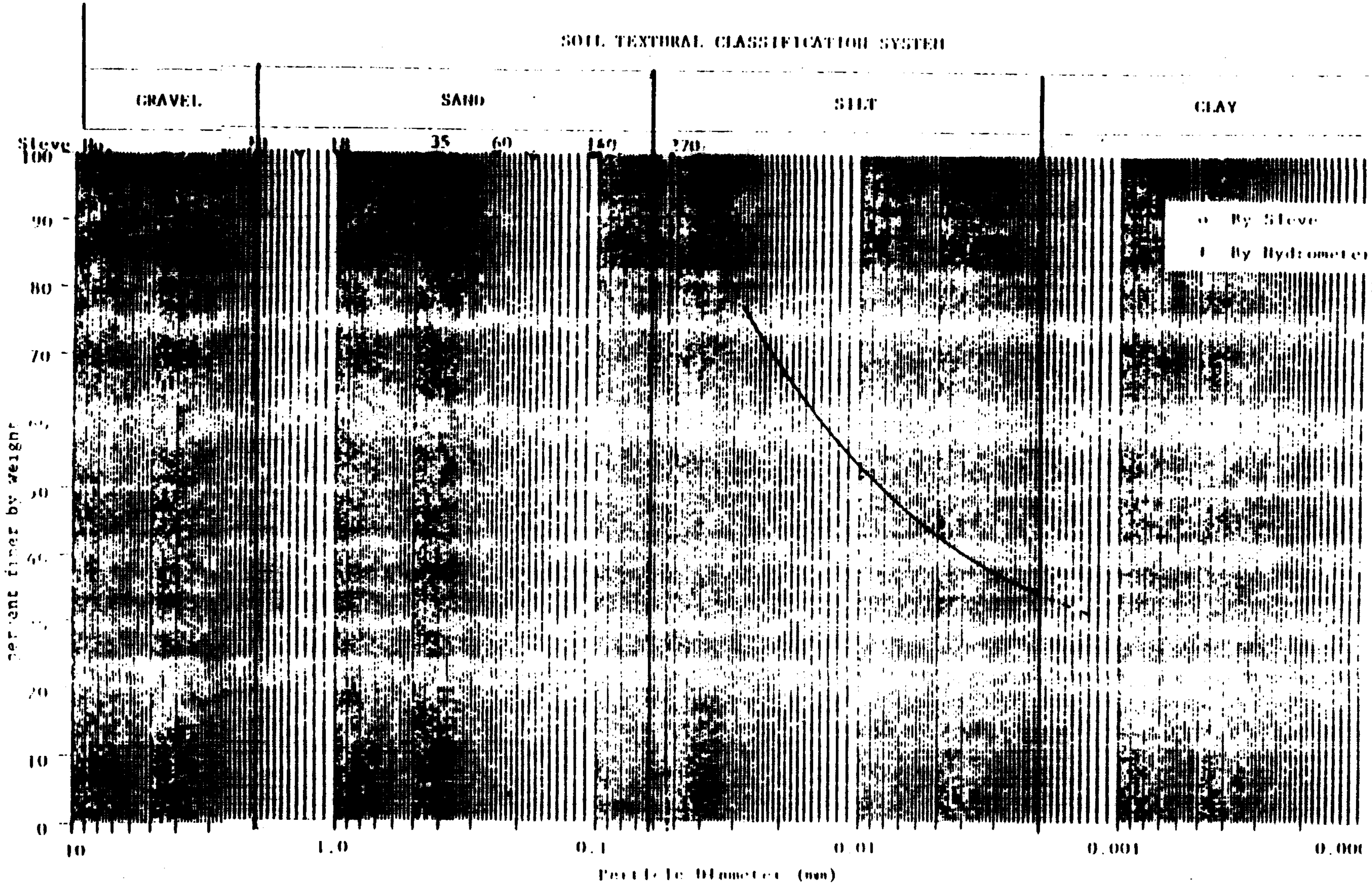
permeabililty:

________ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	NA	5.0	.0193	66.71
18	1.00	Less than 15%	20.0	.0098	52.01
35	.417	of sample	60.0	.0055	44.10
60	.250	larger than	240.	.0025	37.31
140	.105	.053 mm.	360.	.0022	35.05
270	.053				
pan					

COMMENTS



Sample No. (Field) ________ Sample No. (Lab.) ________ Date ________

Illinois Environmental Protection Agency---DLS

Tested By ________

% Gravel & Sand less than 15% % Silt 49.95 or more % Clay 35.05 Name: Clayey Silt

V-78(

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ____________

Laboratory ID No. B 24223

Date Collected 10/9/80

Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	
Source of Sample (boring number, sample number, depth interval in feet) B-3, S-5, 12.5-14.0		
Physical Observations,Remarks		

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
X DISTURBED PERMEABILITY
__ OTHER ____________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeablilty:

3.77×10^{-3} cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0	NA	
18	1.00	100.00	20.0	Less than 15%	of the sample
35	.417	99.98	60.0	is finder than	.053 mm.
60	.250	99.93	240.		
140	.105	33.87	360.		
270	.053	1.17			
pan					

COMMENTS

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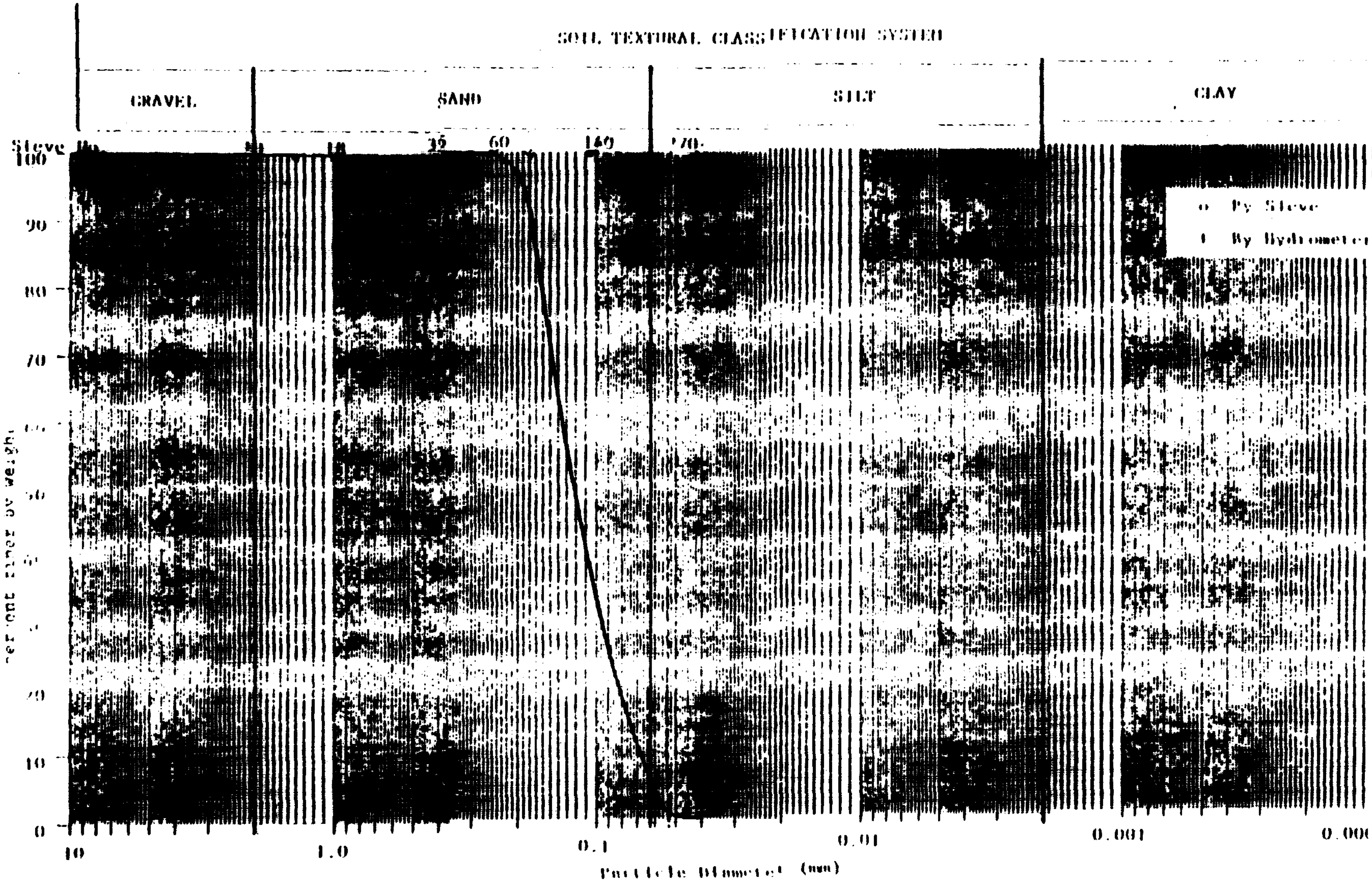
recycled paper ecology and environment



Sample No. (Field) ______________ Sample No. (Lab.) ______________ Date ______________

Tested By ______________

Illinois Environmental Protection Agency---DLS

% Gravel 0 % Sand 95.0 % Silt & Clay 5% Name: Sand

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24224

Date Collected 10/9/80 Date Received Nov.14, 1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-3, S-6, 15.0-16.5

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS

X SIEVE SIZE ANALYSIS

___ UNDISTURBED PERMEABILITY

___ DISTURBED PERMEABILITY

___ OTHER ______________

DATE ANALYSIS COMPLETED ___________

DATE ANAYSIS REPORTED ___________

TEST RESULTS

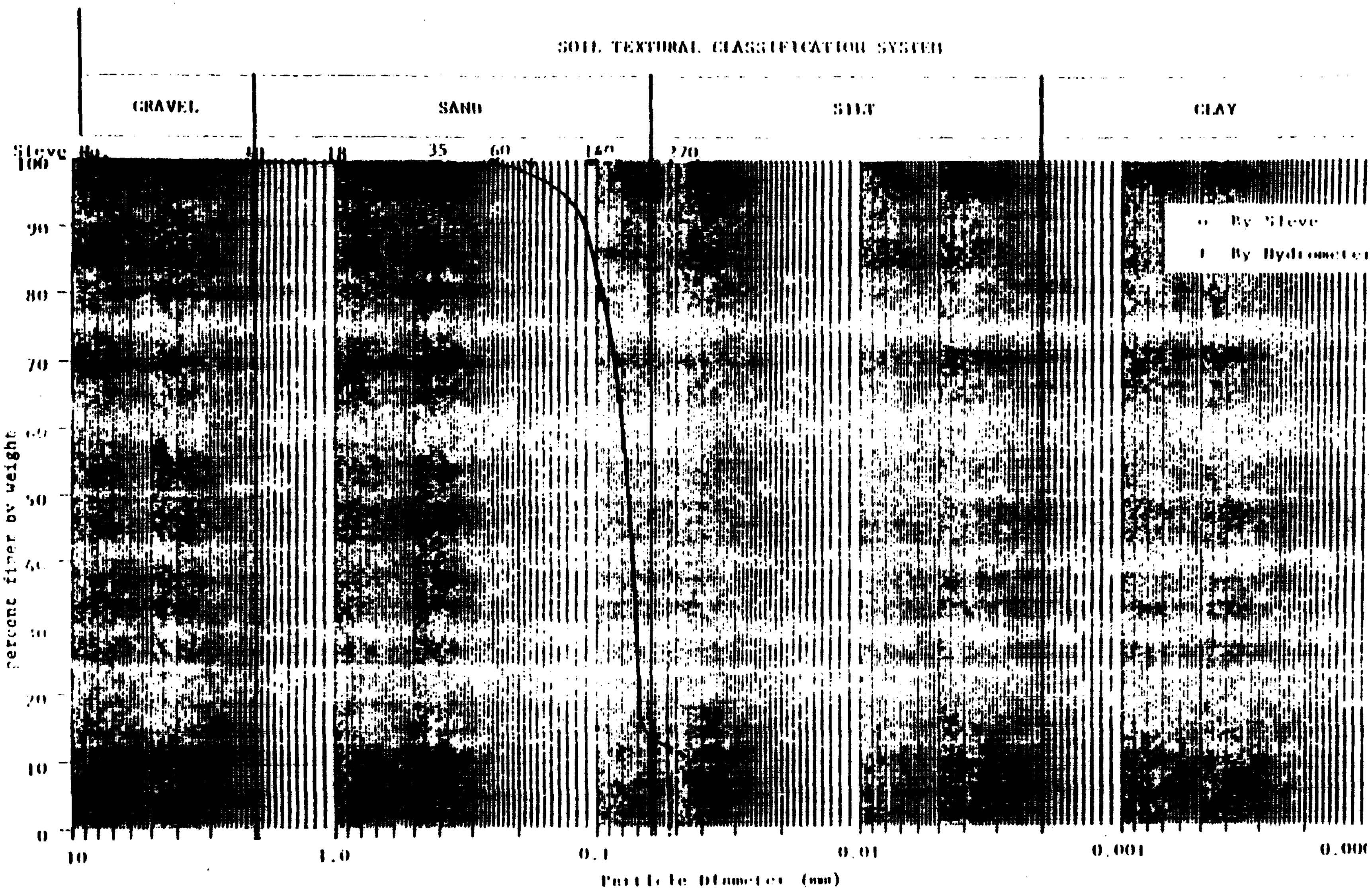
permeablilty:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.99	5.0	NA	
18	1.00	99.98	20.0	Less than 15%	of
35	.417	99.97	60.0	sample finer	than
60	.250	99.90	240.	.053 mm.	
140	.105	83.37	360.		
270	.053	10.90			
pan					

COMMENTS



Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Tested By ______

Illinois Environmental Protection Agency---DLS

% Gravel 0 % Sand 89 % Silt 11 % Clay 0 Name: Sand w/some silt

4-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24225

Date Collected 10/9/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	
Source of Sample (boring number, sample number, depth interval in feet) B-3, S-7, 20.0-21.5		
Physical Observations, Remarks		

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS

X SIEVE SIZE ANALYSIS

___ UNDISTURBED PERMEABILITY

___ DISTURBED PERMEABILITY

___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

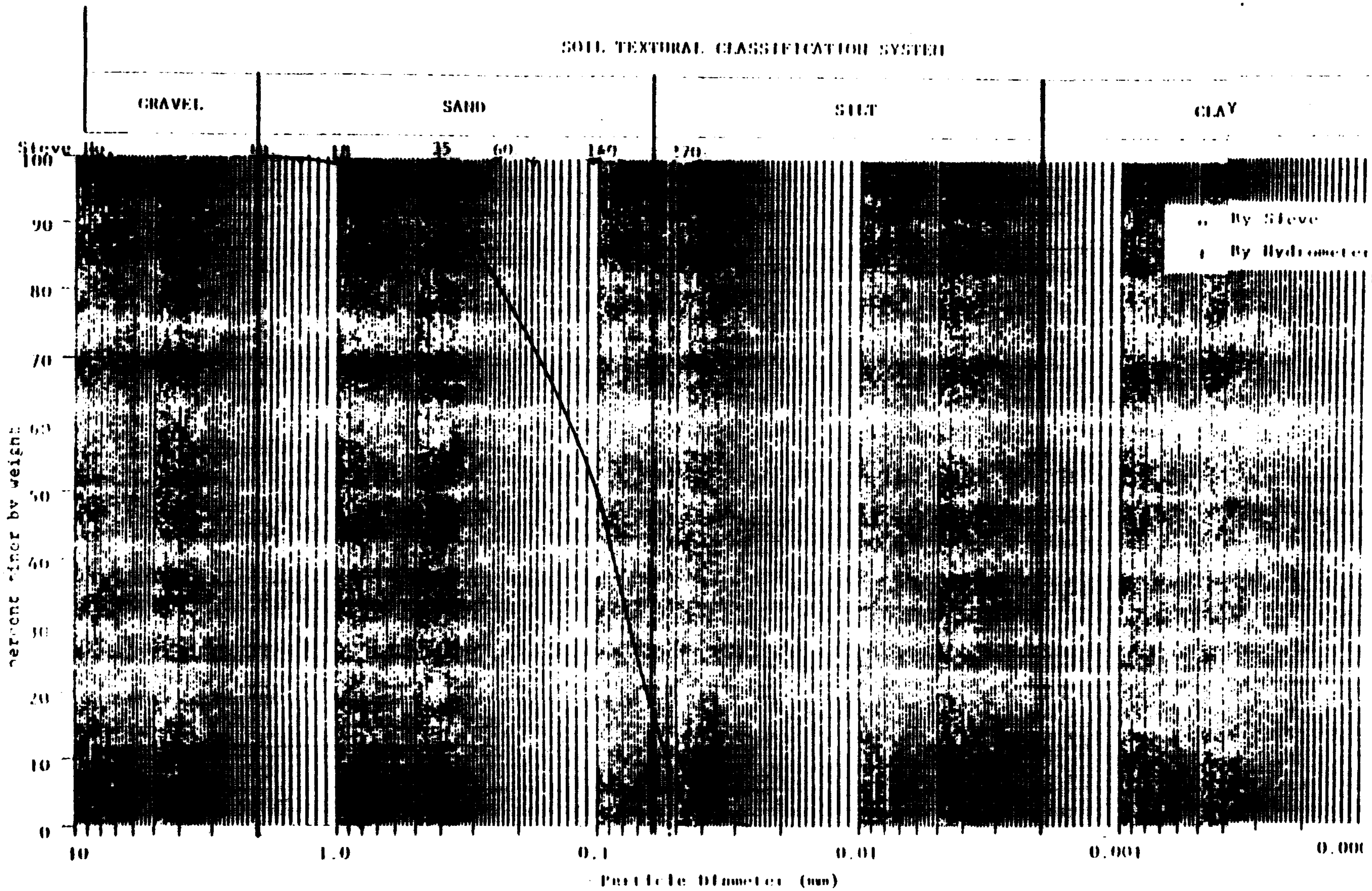
permeability:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.74	5.0	NA	
18	1.00	98.13	20.0	Less than	15 % of
35	.417	92.98	60.0	sample finer than	
60	.250	82.38	240.	.053 mm.	
140	.105	49.52	360.		
270	.053	10.17			
pan					

COMMENTS



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Illinois Environmental Protection Agency---DLS

Tested By ____________

% Gravel .26 % Sand 82.74 % Silt 17.0 % Clay 0 Name: Sand w/some silt

<-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24226

Date Collected 10/9/80 Date Received Nov. 14, 1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-3, S-8, 25.0-26.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ______________

DATE ANALYSIS COMPLETED ______________

DATE ANAYSIS REPORTED ______________

TEST RESULTS

permeability:

________ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.87	5.0	NA	
18	1.00	99.64	20.0	Less than	15%
35	.417	97.66	60.0	of sample	finer than
60	.250	83.09	240.	.053 mm.	
140	.105	18.70	360.		
270	.053	4.51			
pan					

COMMENTS recycled paper ecology and environment

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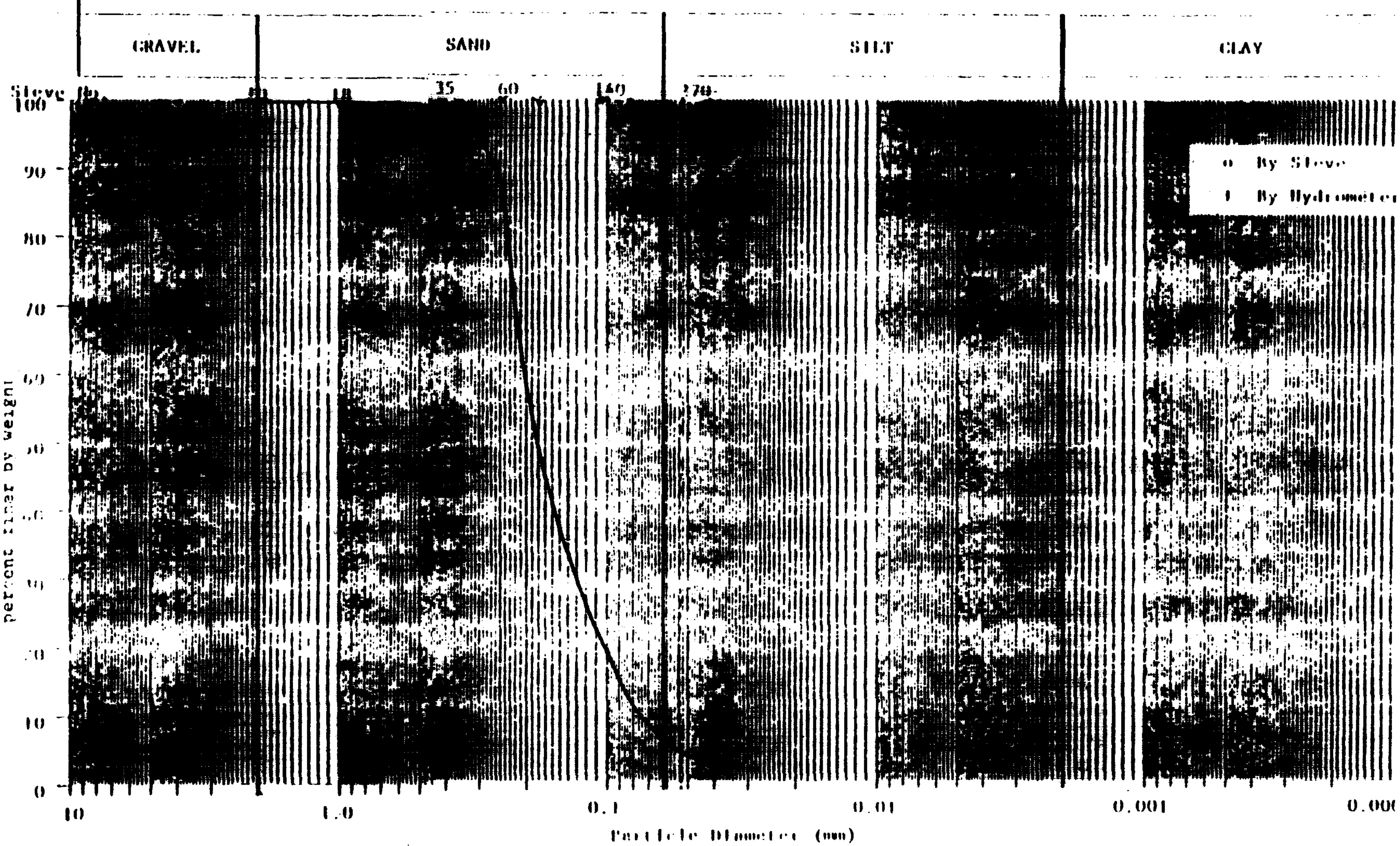
SOIL TEXTORAL CLASSIFICATION SYSTEM



Sample No. (Field) ____________ Sample No. (Lab.) Date ________

Illinois Environmental Protection Agency --DLS Tested By ________

% Gravel .13 % Sand 95.36 % Silt & Clay 4.51 Name: Sand

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______

Laboratory ID No. B 24229

Date Collected 10/9/80

Date Received Nov. 14, 1980

Division Program Code ______

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-3, S-10, 30.0-31.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ______

DATE ANALYSIS COMPLETED ______

DATE ANAYSIS REPORTED ______

TEST RESULTS

permeability:

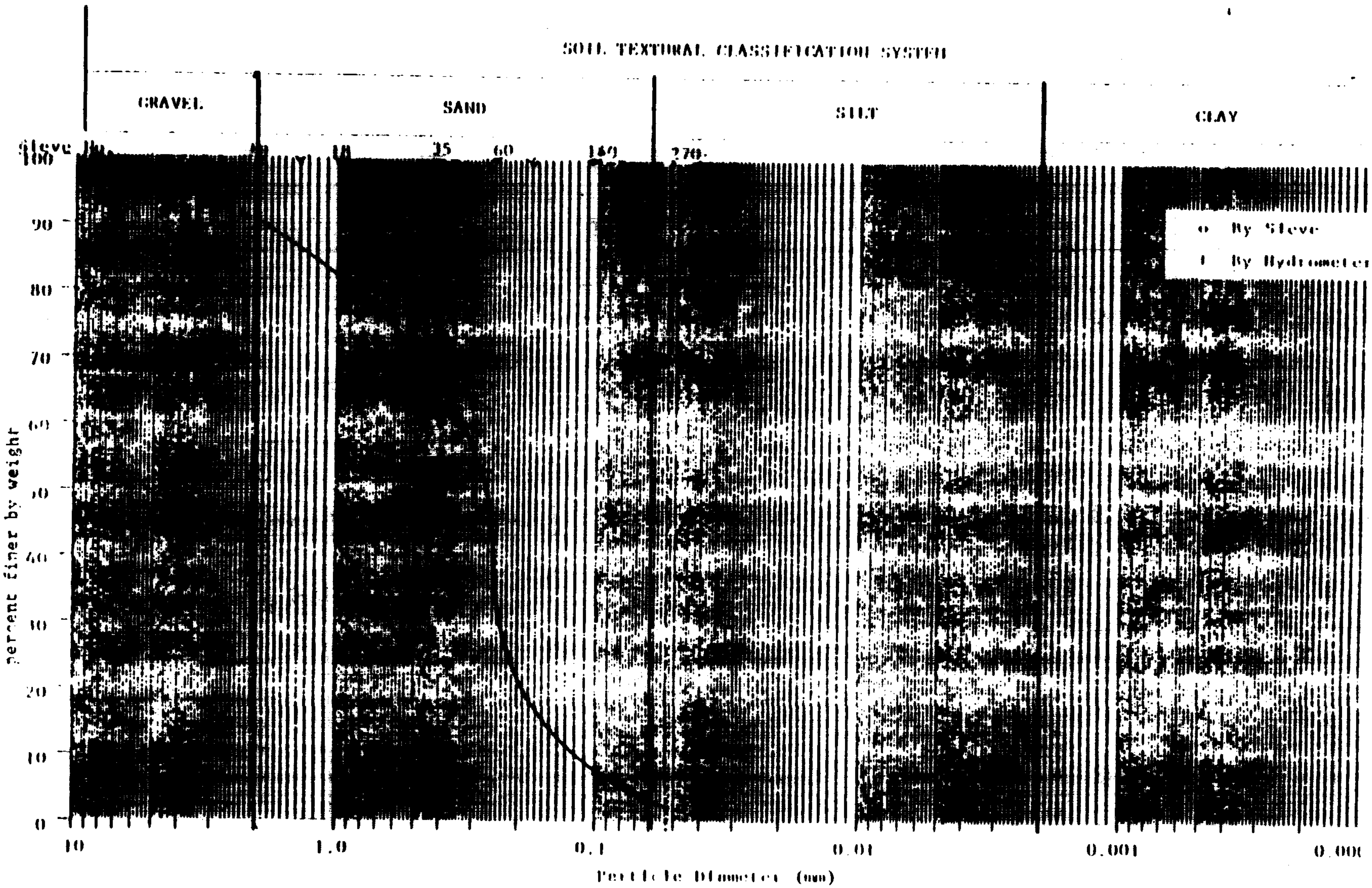
______ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	90.83	5.0	NA	
18	1.00	83.98	20.0	Less than 15% of	
35	.417	65.82	60.0	sample is finer	
60	.250	39.28	240.	than .053 mm.	
140	.105	7.52	360.		
270	.053	3.01			
pan					

COMMENTS

SOIL TEXTURAL CLASSIFICATION SYSTEM



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Illinois Environmental Protection Agency---DLS

Tested By ____

% Gravel 9.17 % Sand 87.82 % Silt & Clay 3.01%

Name: Sand w/some gravel

V-78(

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________

Laboratory ID No. B 24228

Date Collected 10/9/80

Date Received Nov. 14, 1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-3, S-11, 35.0-36.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
X DISTURBED PERMEABILITY
__ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability:

4.1×10^{-3} cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	97.39	5.0	NA	
18	1.00	90.46	20.0	Less than	15% of
35	.417	56.37	60.0	sample finer than	
60	.250	22.52	240.	.053 mm.	
140	.105	2.92	360.		
270	.053	1.24			
pan					

COMMENTS

recycled paper

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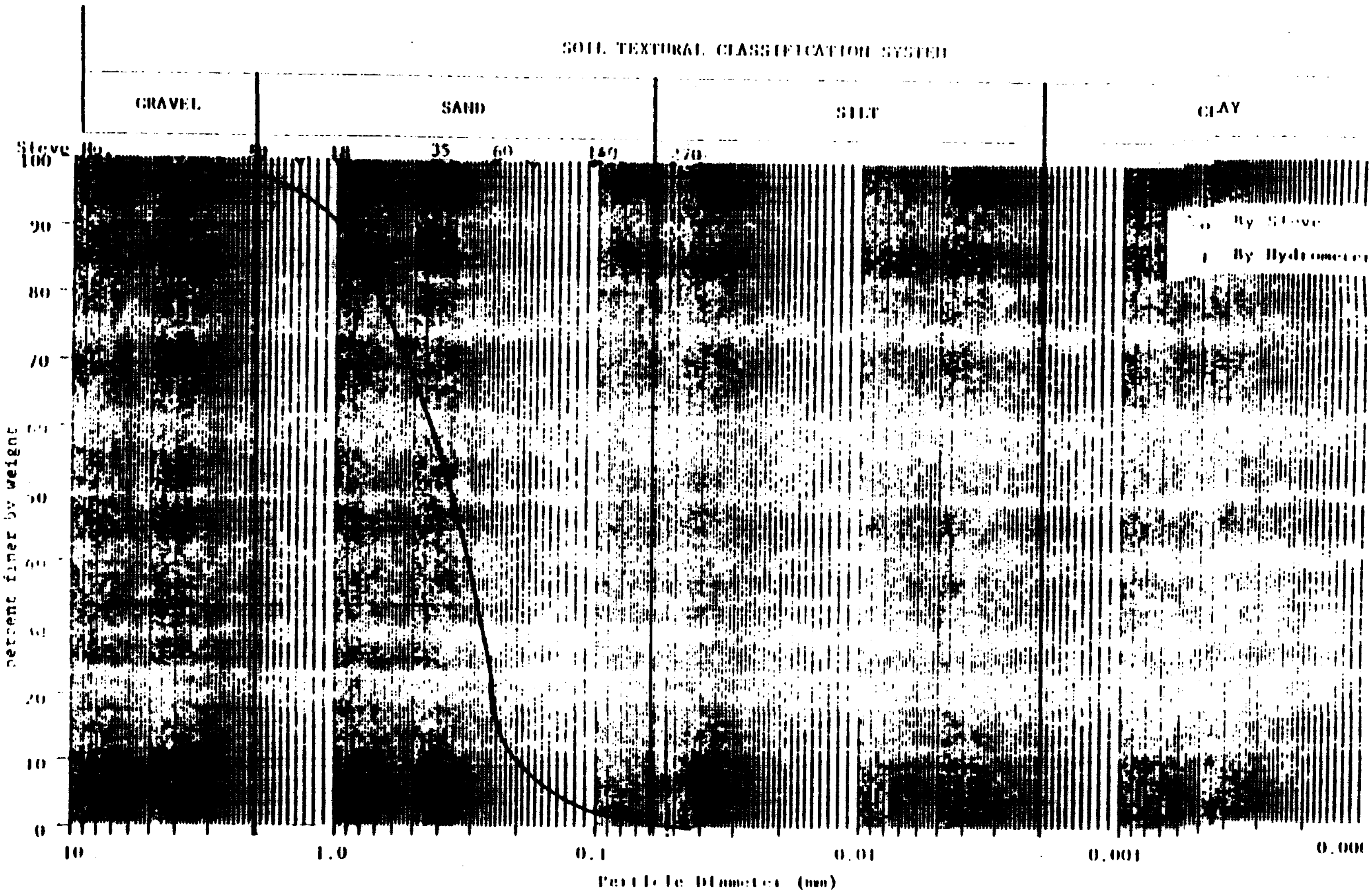


Sample No. (Field) ____________ Sample No. (Lab.) ____ Date ______

Illinois Environmental Protection Agency---DLS Tested By ______

% Gravel 2.61 % Sand 96.15 % Silt & Clay 1.24 Name: Sand

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24209

Date Collected 10/9/80 Date Received Nov.14.1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-4, S-1, 0.0-2.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ___________

DATE ANAYSIS REPORTED ___________

TEST RESULTS

permeability:

__________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0 *	0.0140	15.7
18	1.00	100.00	20.0	0.0086	12.3
35	.417	99.96	60.0	0.0049	10.9
60	.250	99.51	240.	0.0023	9.5
140	.105	90.33	360.	0.0020	9.5
270	.053	44.40			
pan					

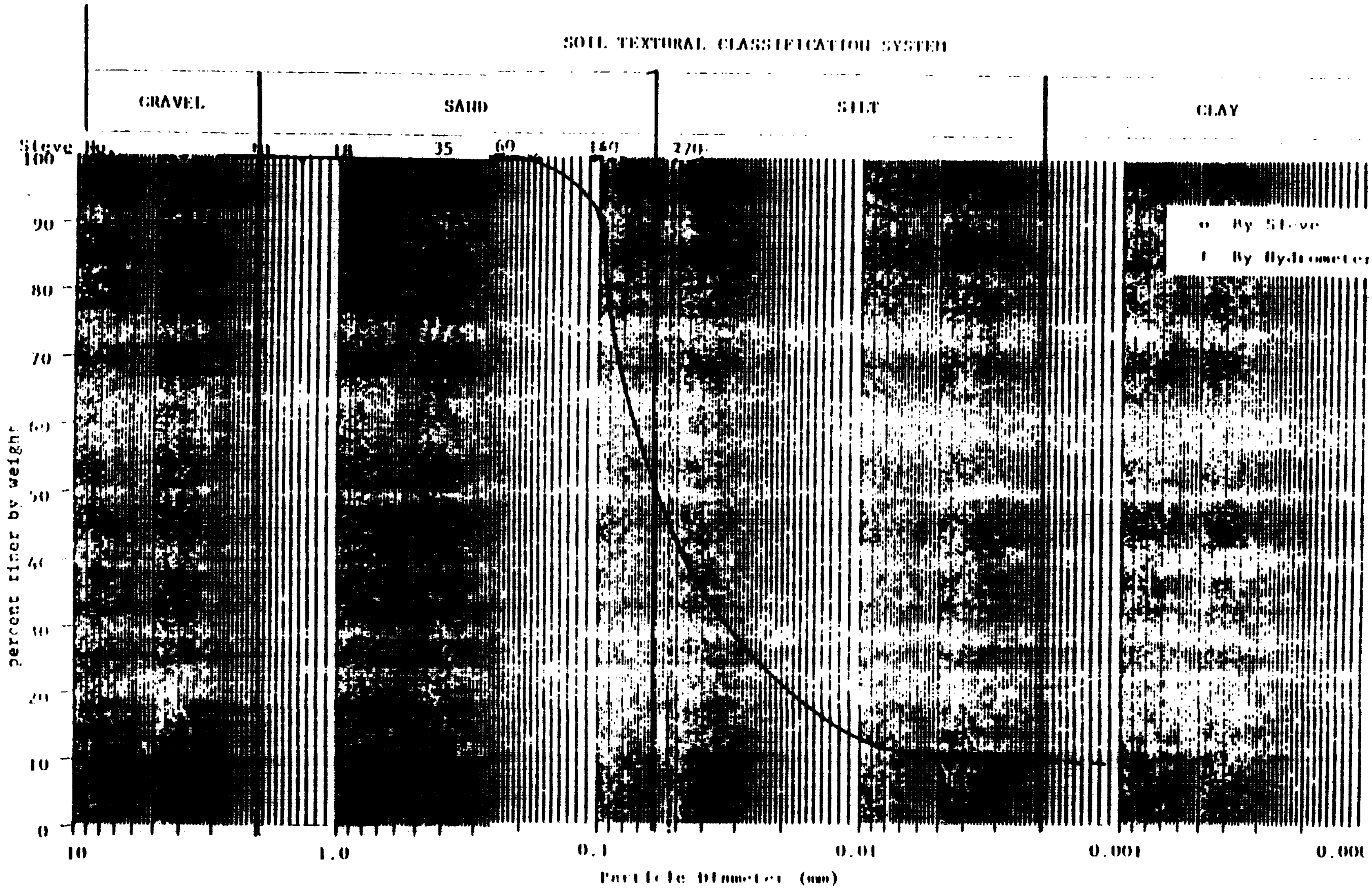
COMMENTS * 7.75 m

recycled paper

ecology and environment

recycled paper

ecology and environment



Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Illinois Environmental Protection Agency--DLS Tested By ______

% Gravel 0 % Sand 58 % Silt 32.5 % Clay 9.5 Name: Silty Sand w/some clay

V-781

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24210

Date Collected 10/9/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-4, S-2, 2.5-4.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ______________

DATE ANAYSIS REPORTED ______________

TEST RESULTS

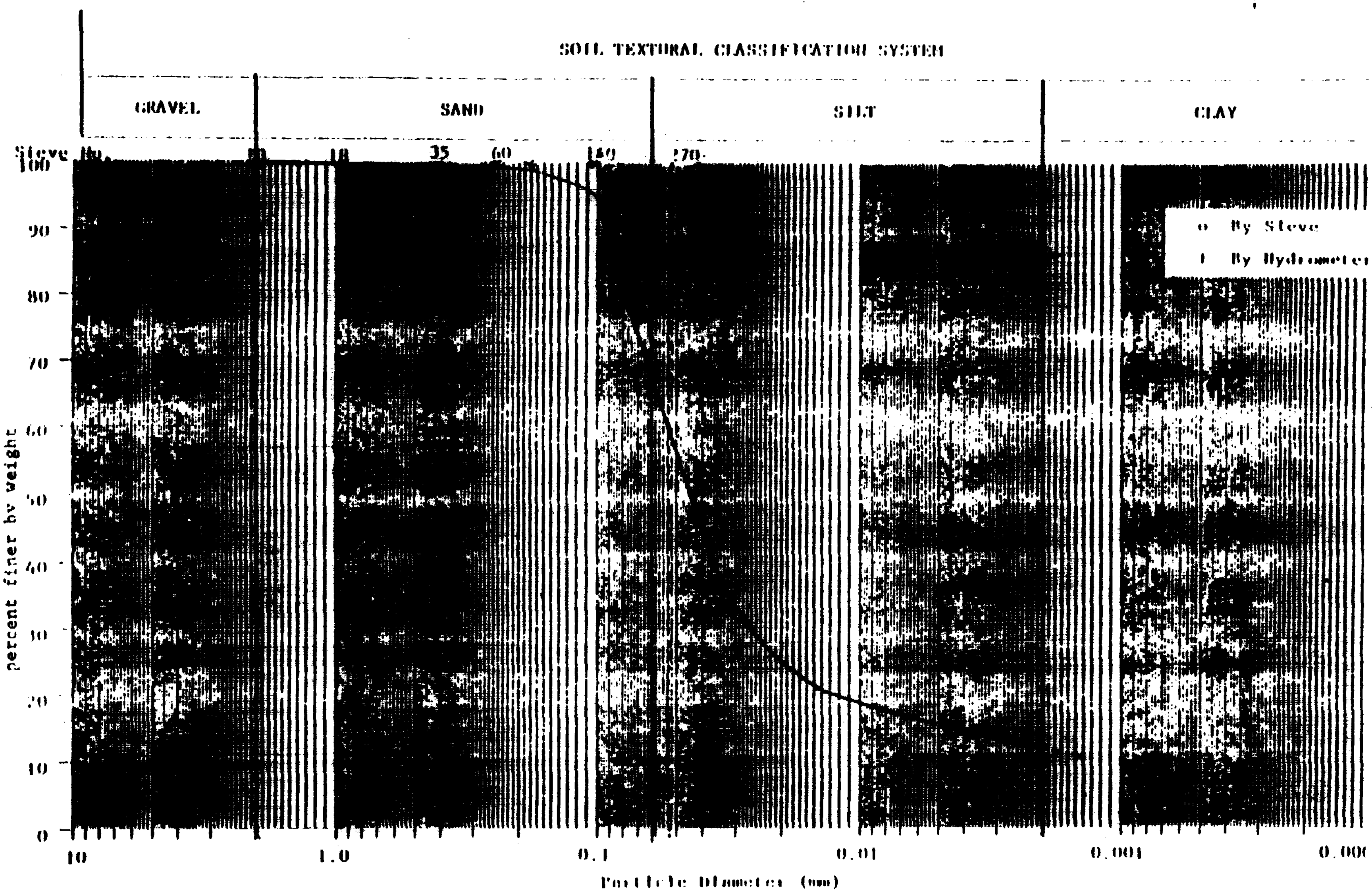
permeablilty:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0	.0148	21.91
18	1.00	99.98	20.0	.0087	18.10
35	.417	99.92	60.0	.0049	15.24
60	.250	99.82	240.	.0023	13.33
140	.105	94.87	360.	.0020	12.39
270	.053	59.90			
pan					

COMMENTS



Sample No. (Field) ____________ Sample No. (Lab.) ____ Date ________

Tested By ________

Illinois Environmental Protection Agency---DLS

% Gravel 0 % Sand 33 % Silt 64.61 % Clay 12.39 Name: Sandy Silt w/some clay

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24211

Date Collected 10/9/80 Date Received Nov.14.1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-4, S-3, 5.0-6.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ____________
DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeabiilty:
________ cm/sec

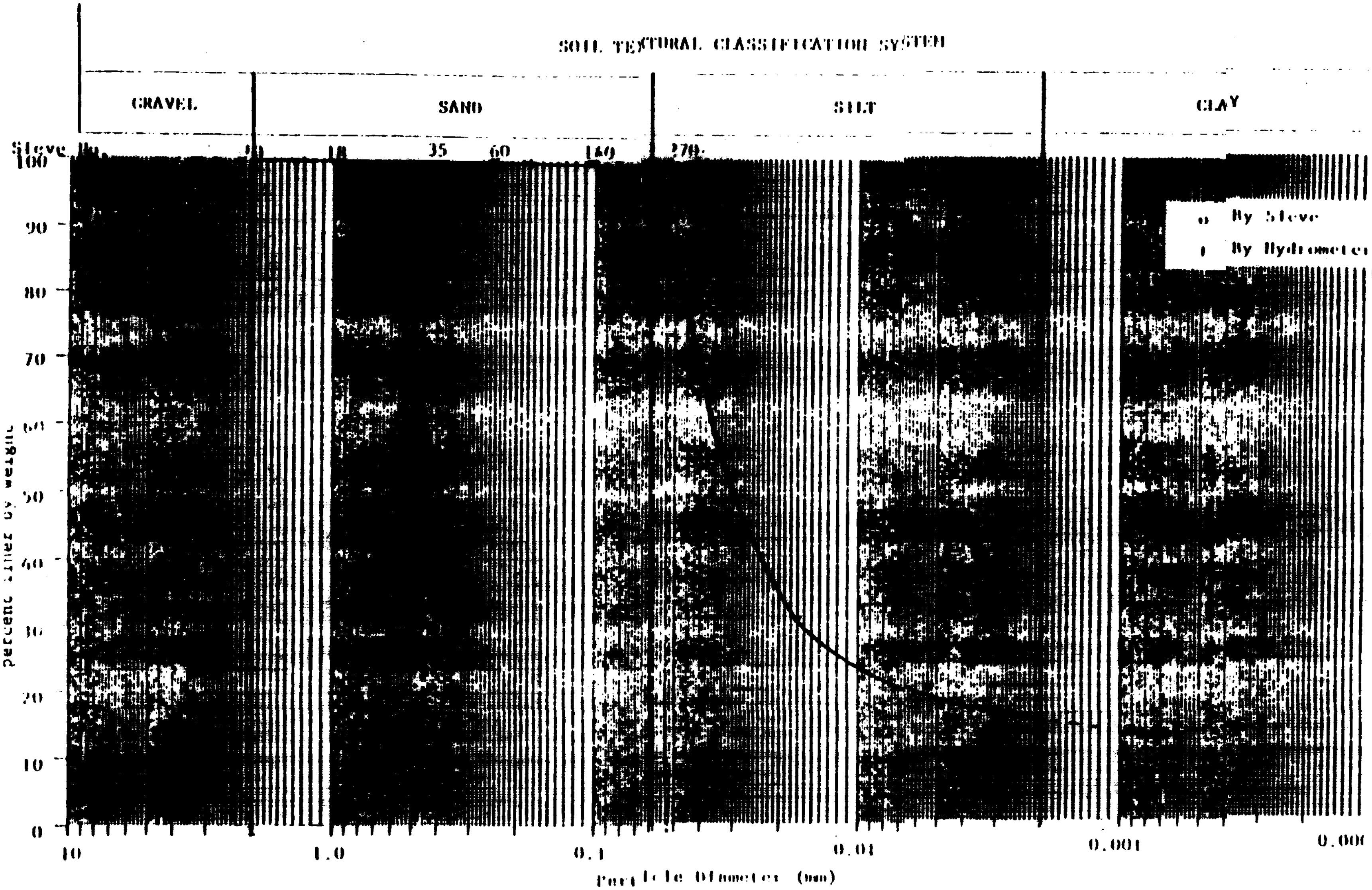
grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0	.0171	30.73
18	1.00	99.96	20.0	.0095	22.90
35	.417	99.88	60.0	.0054	19.88
60	.250	99.82	240.	.0025	16.87
140	.105	98.72	360.	.0021	15.67
270	.053	87.98			
pan					

COMMENTS ______________

recycled paper ecology and environment

recycled paper ecology and environment



Sample No. (Field) ________________ Sample No. (Lab.) ____________ Date ____________

Tested By ________

Illinois Environmental Protection Agency---DLS

% Gravel 0 % Sand 6 % Silt 8ø.33 % Clay 15.67 Name: Clayey Silt w/some sand

V-78

Time Collected ______________ Laboratory ID No. B 24214

Date Collected 10/9/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-4, S-6, 12.5-14.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeablilty:

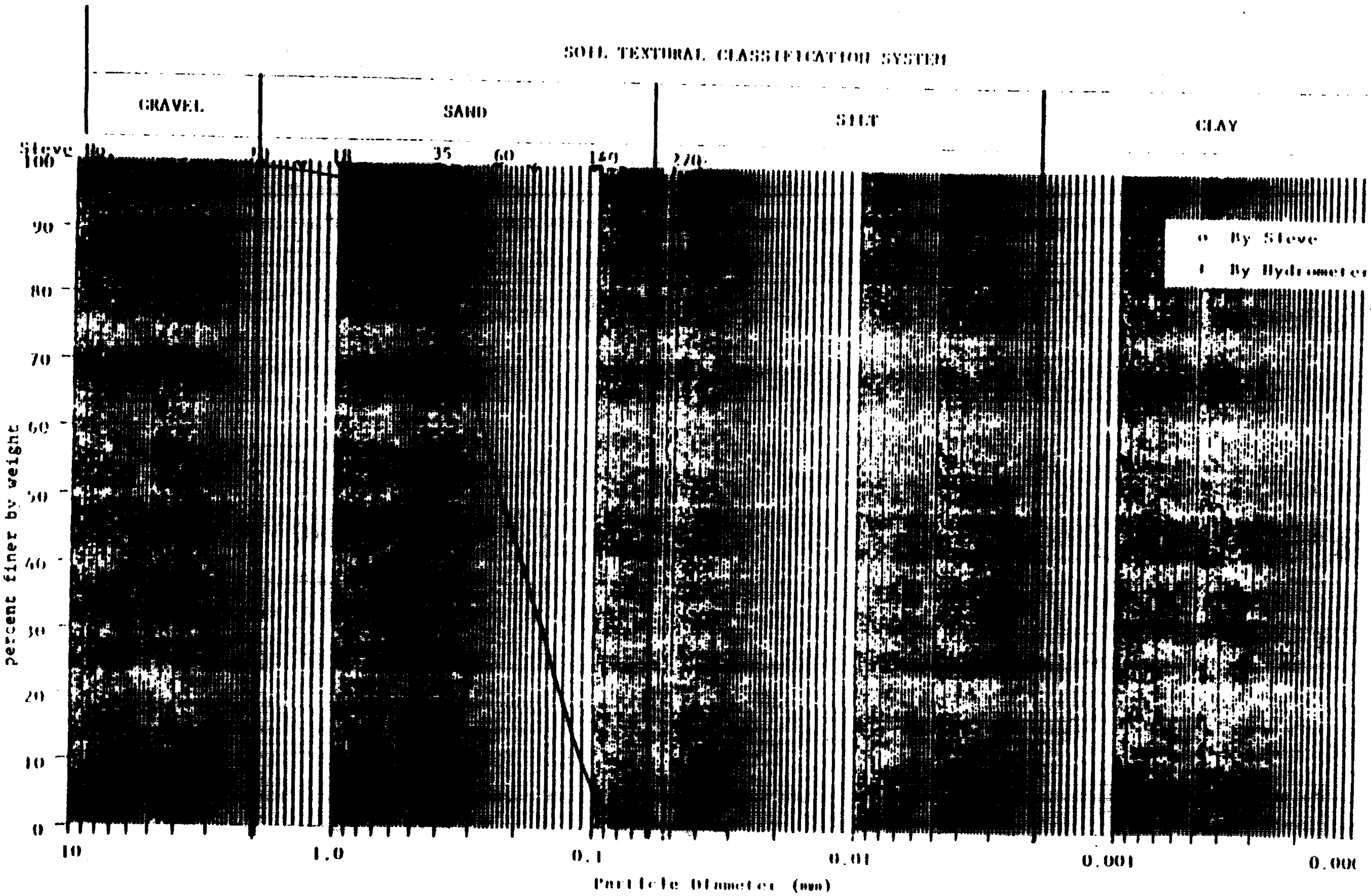
________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.46	5.0	Less than	NA
18	1.00	97.84	20.0	15% of	NA
35	.417	83.48	60.0	sample finer	NA
60	.250	48.14	240.	than .053 mm.	NA
140	.105	5.79	360.		NA
270	.053	1.66			
pan					

COMMENTS

SOIL TEXTURAL CLASSIFICATION SYSTEM

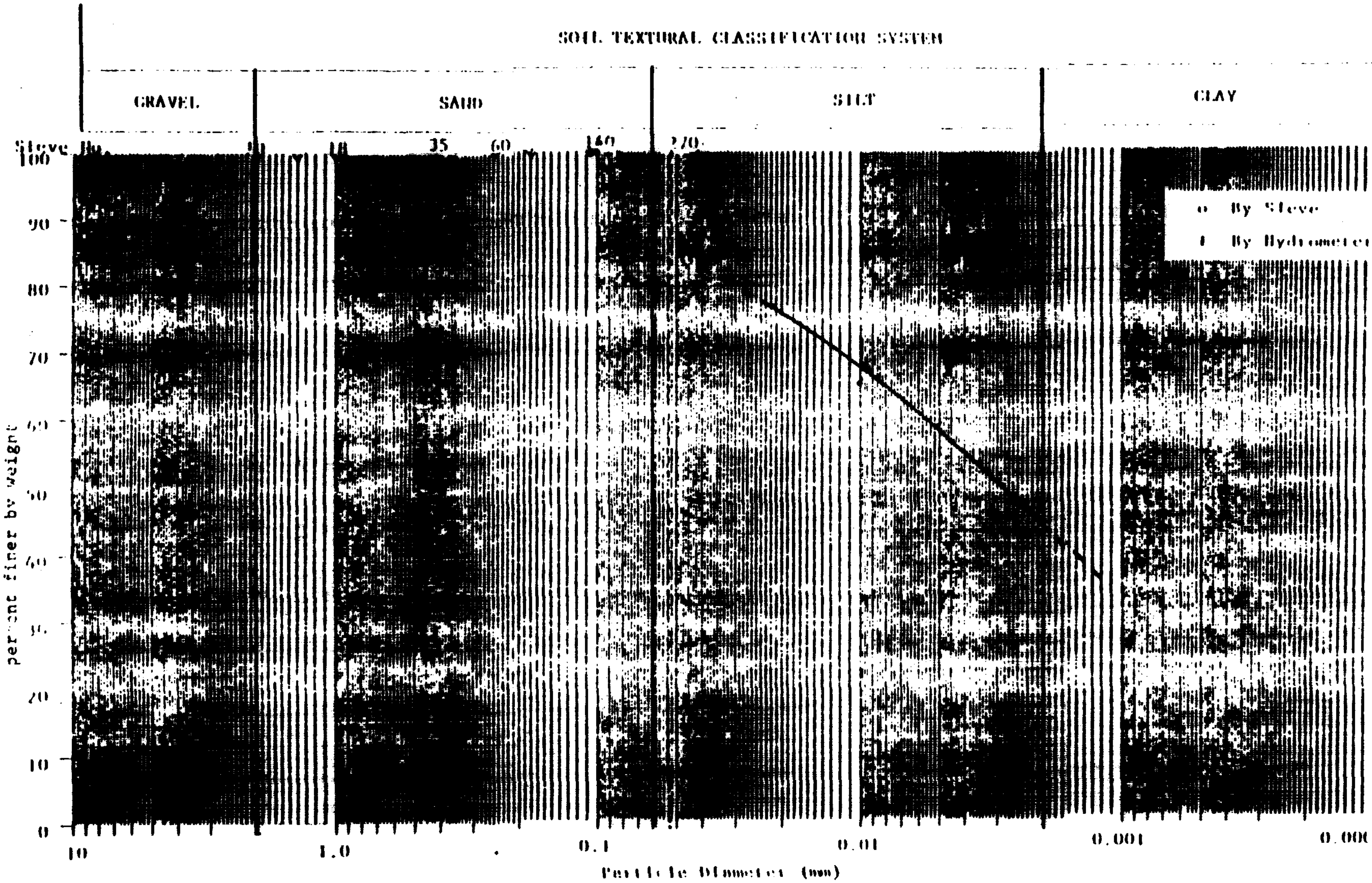


Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Illinois Environmental Protection Agency---DLS Tested By ______

% Gravel 0.54 % Sand 97.8 % Silt & Clay 1.66 Name: Sand

V-78



Sample No. (Field) ________ Sample No. (Lab.) ________ Date ________

Illinois Environmental Protection Agency--DLS Tested By ________

% Gravel & Sand less than 15% % Silt 39.7 or more % Clay 45.30 Name: Silty Clay

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24239

Date Collected 10/20/80 Date Received Nov.14.1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

B-8, S-2, 2.5-4.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeablilty:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.87	5.0	.0185	13.07
18	1.00	99.55	20.0	.0088	9.80
35	.417	99.26	60.0	.0050	8.17
60	.250	98.98	240.	.0025	7.35
140	.105	95.70	360.	.0020	6.54
270	.053	46.13			
pan					

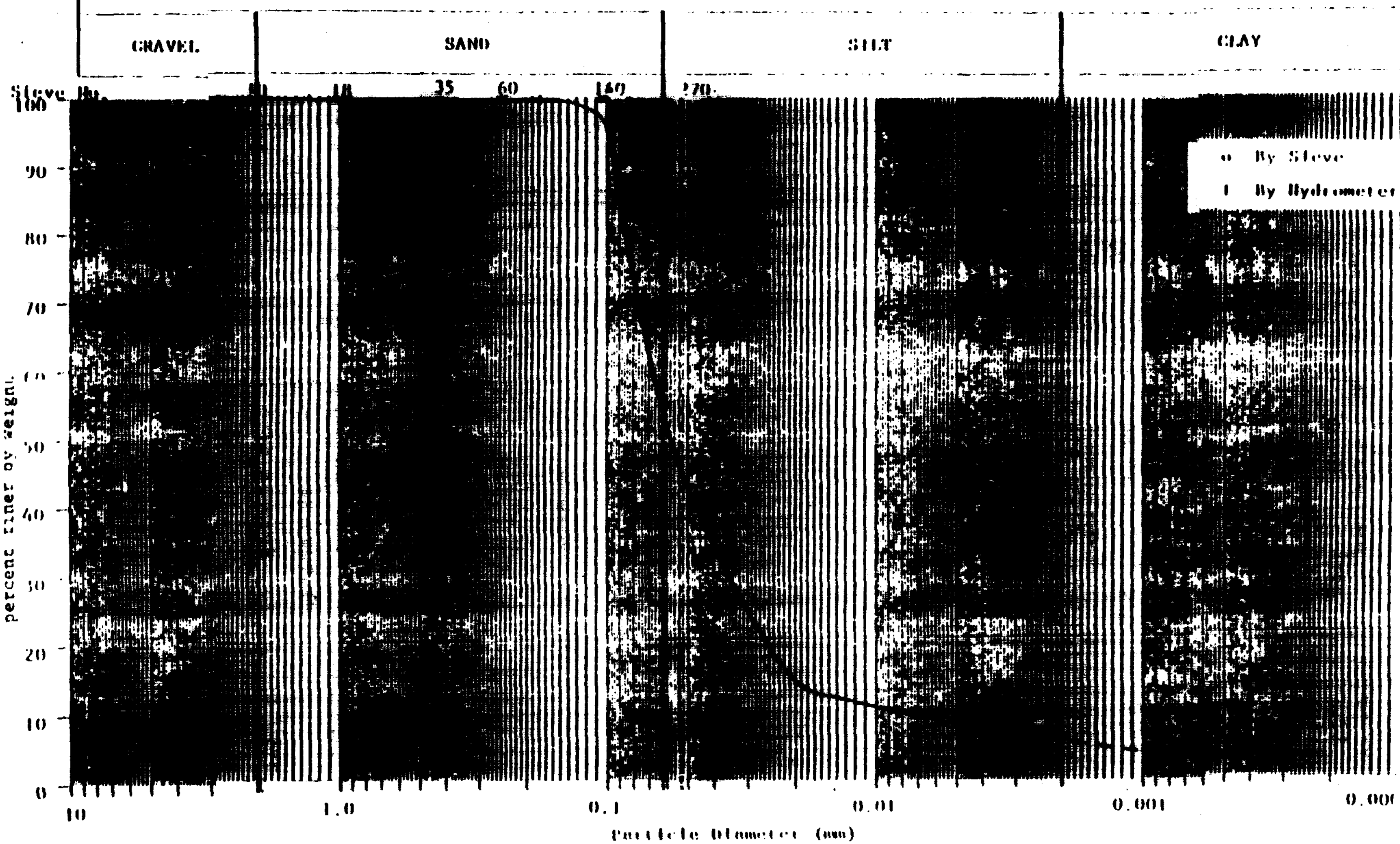
COMMENTS

recycled paper ecology and environment

IPC 26 7/80

recycled paper ecology and environment

SOIL TEXTURAL CLASSIFICATION SYSTEM



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Tested By ____________

Illinois Environmental Protection Agency--DLS

% Gravel 0.13 % Sand 48 % Silt 45.33 % Clay 6.54 Name: Silty Sand w/some clay

V-78

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24240

Date Collected 10/20/80 Date Received Nov. 14, 1980

Division Program Code ________

County St. Clair	File Heading Dead Creek/Cahokia	File Number
Source of Sample (boring number, sample number, depth interval in feet) B-8, S-3, 5.0-6.5		
Physical Observations, Remarks		

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ______________

DATE ANALYSIS COMPLETED __________

DATE ANAYSIS REPORTED __________

TEST RESULTS

permeability:

________ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.93	5.0	.0188	22.49
18	1.00	99.74	20.0	.0085	13.74
35	.417	99.59	60.0	.0050	11.24
60	.250	99.43	240.	.0025	9.99
140	.105	85.55	360.	.0019	6.25
270	.053	61.59			
pan					

COMMENTS

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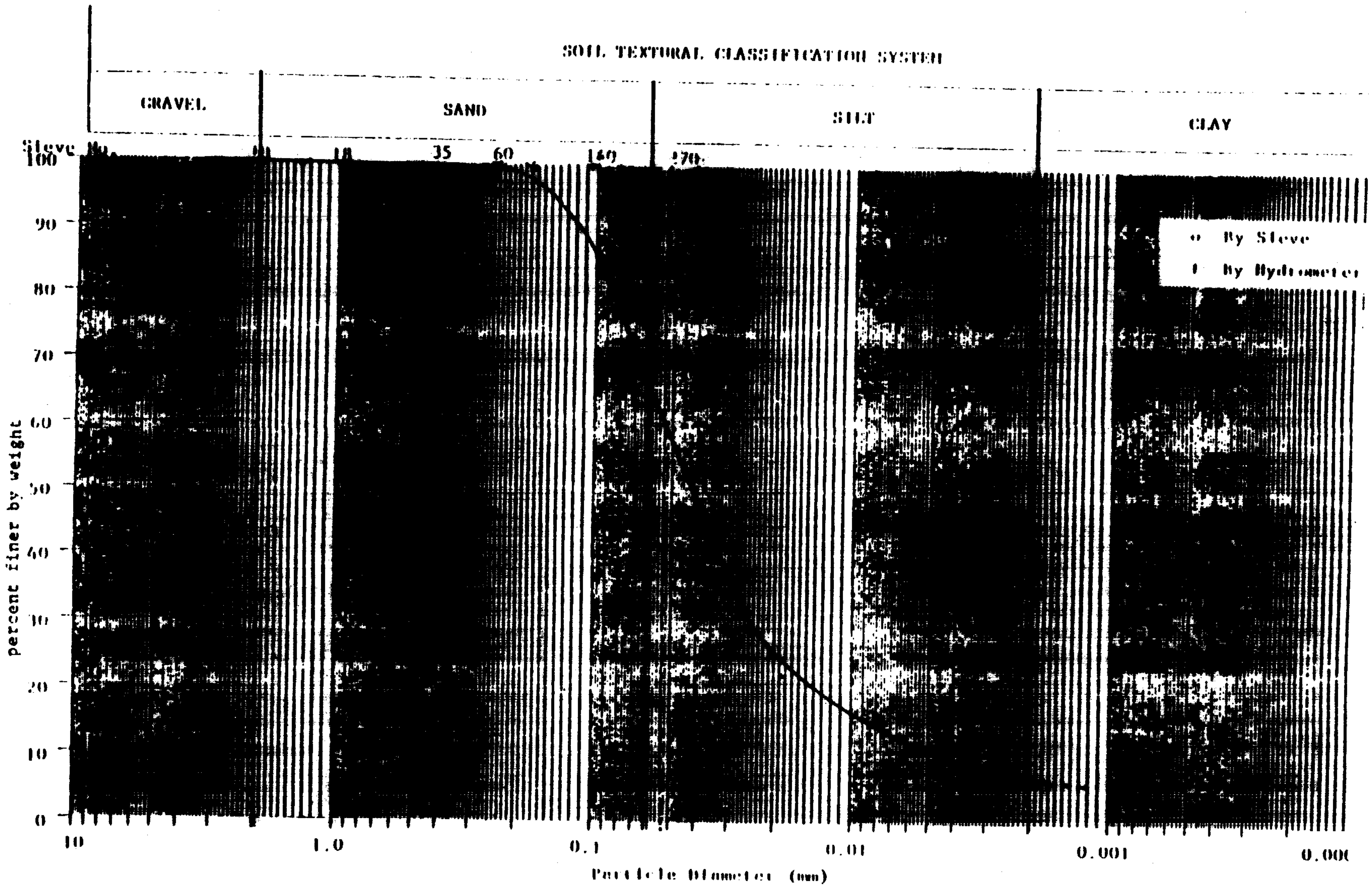
recycled paper ecology and environment



Sample No. (Field) ________ Sample No. (Lab.) ________ Date ________

Illinois Environmental Protection Agency---DLS Tested By ________

% Gravel 0.07 % Sand 33 % Silt 60.68 % Clay 6.25 Name: Sandy Silt w/some clay

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24242

Date Collected 10/20/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
B-8, S-5, 10.0-11.5

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability:

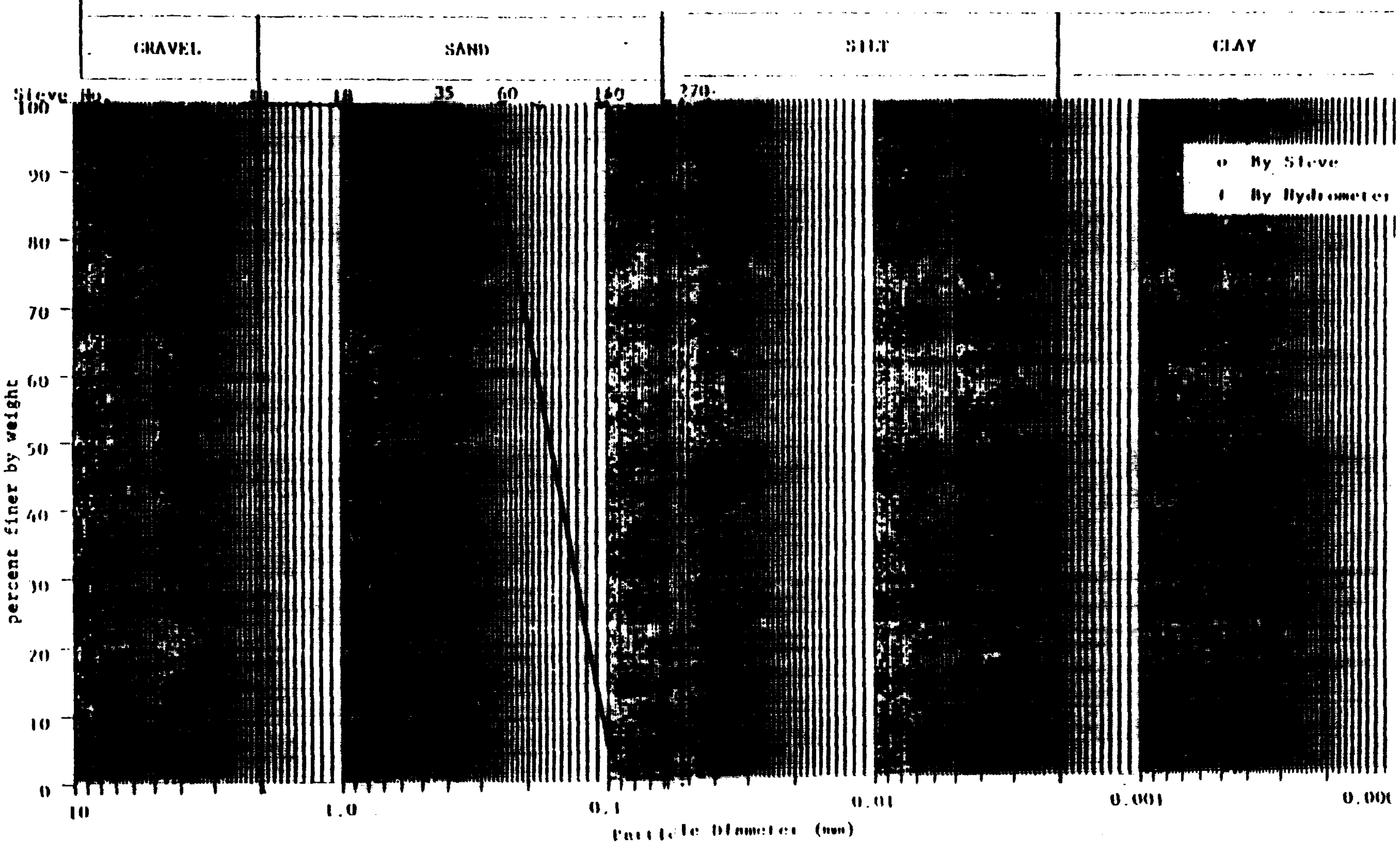
________ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.98	5.0	NA	
18	1.00	99.93	20.0	Less than	15% of sample
35	.417	99.75	60.0	finer than	.053 mm.
60	.250	79.17	240.		
140	.105	4.97	360.		
270	.053	1.55			
pan					

COMMENTS

SOIL TEXTURAL CLASSIFICATION SYSTEM



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Tested By ____________

Illinois Environmental Protection Agency---DLS

% Gravel 0.02 % Sand 98.43 % Silt& Clay 1.55%

Name: Sand

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ____________ Laboratory ID No. B 24230

Date Collected 10/30/80 Date Received Nov.14.1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

P-4, S-1, 0.0-1.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS

X SIEVE SIZE ANALYSIS

___ UNDISTURBED PERMEABILITY

___ DISTURBED PERMEABILITY

___ OTHER ____________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability:

________ cm/sec

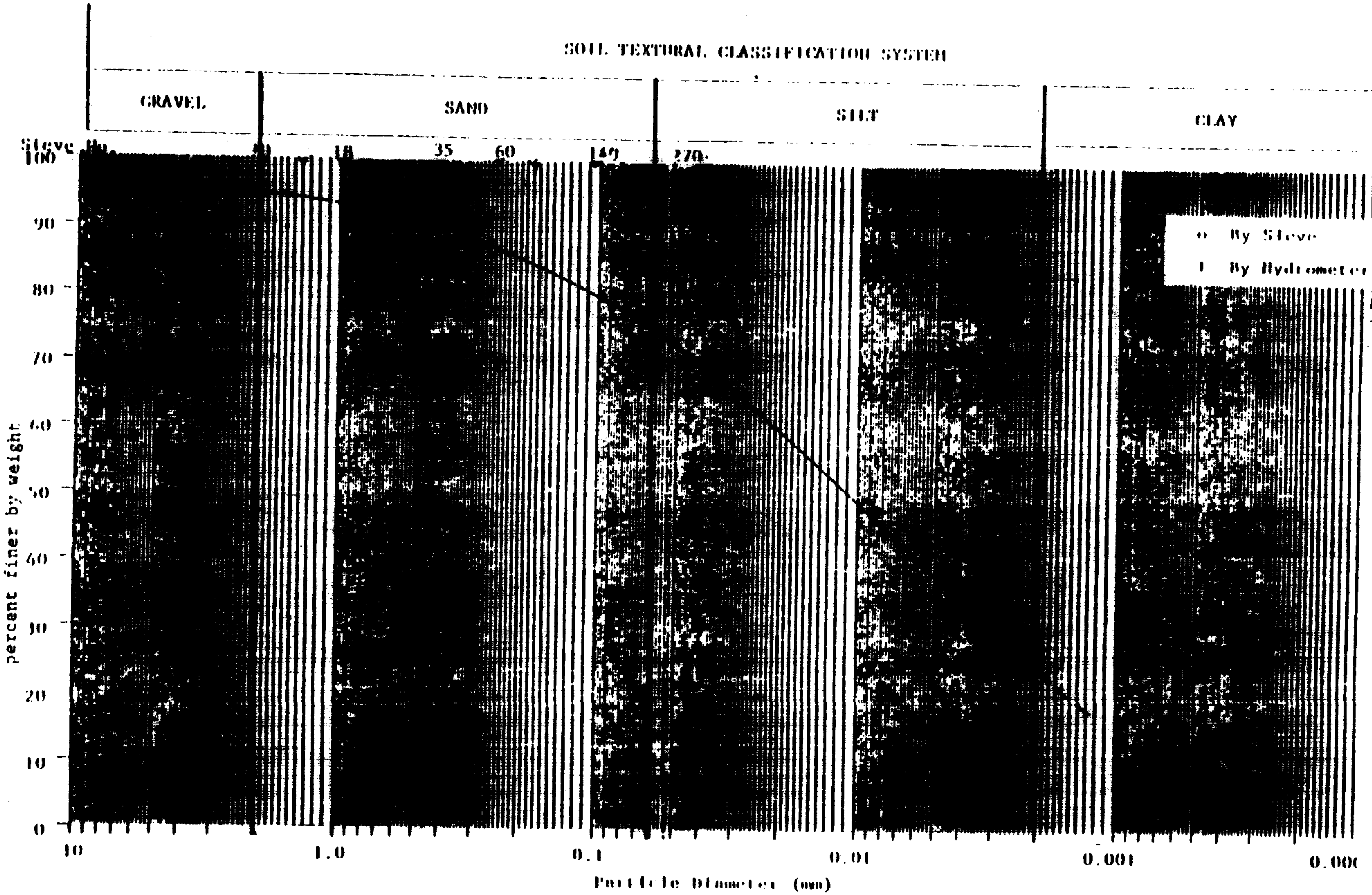
grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	95.38	5.0	.0205	62.46
18	1.00	93.32	20.0	.0098	46.60
35	.417	90.27	60.0	.0055	37.68
50	.250	86.07	240.	.0025	28.75
140	.105	80.38	360.	.0021	26.77
270	.053	75.13			
pan					

COMMENTS ____________

recycled paper ecology and environment

SOIL TEXTURAL CLASSIFICATION SYSTEM



Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Illinois Environmental Protection Agency---DLS Tested By ______

% Gravel 4.62 % Sand 20.0 % Silt 48.61 % Clay 26.77 Name: Sandy, Clayey, Silt

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________

Laboratory ID No. B 24231

Date Collected 10/30/80

Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

P-4, S-2, 1.0-2.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	NA	5.0	.0199	79.69
18	1.00	Less than	20.0	.0095	59.38
35	.417	15% of sample	60.0	.0053	50.00
60	.250	greater than	240.	.0025	42.19
140	.105	.053 mm.	360.	.0021	39.06
270	.053				
pan					

COMMENTS ______________

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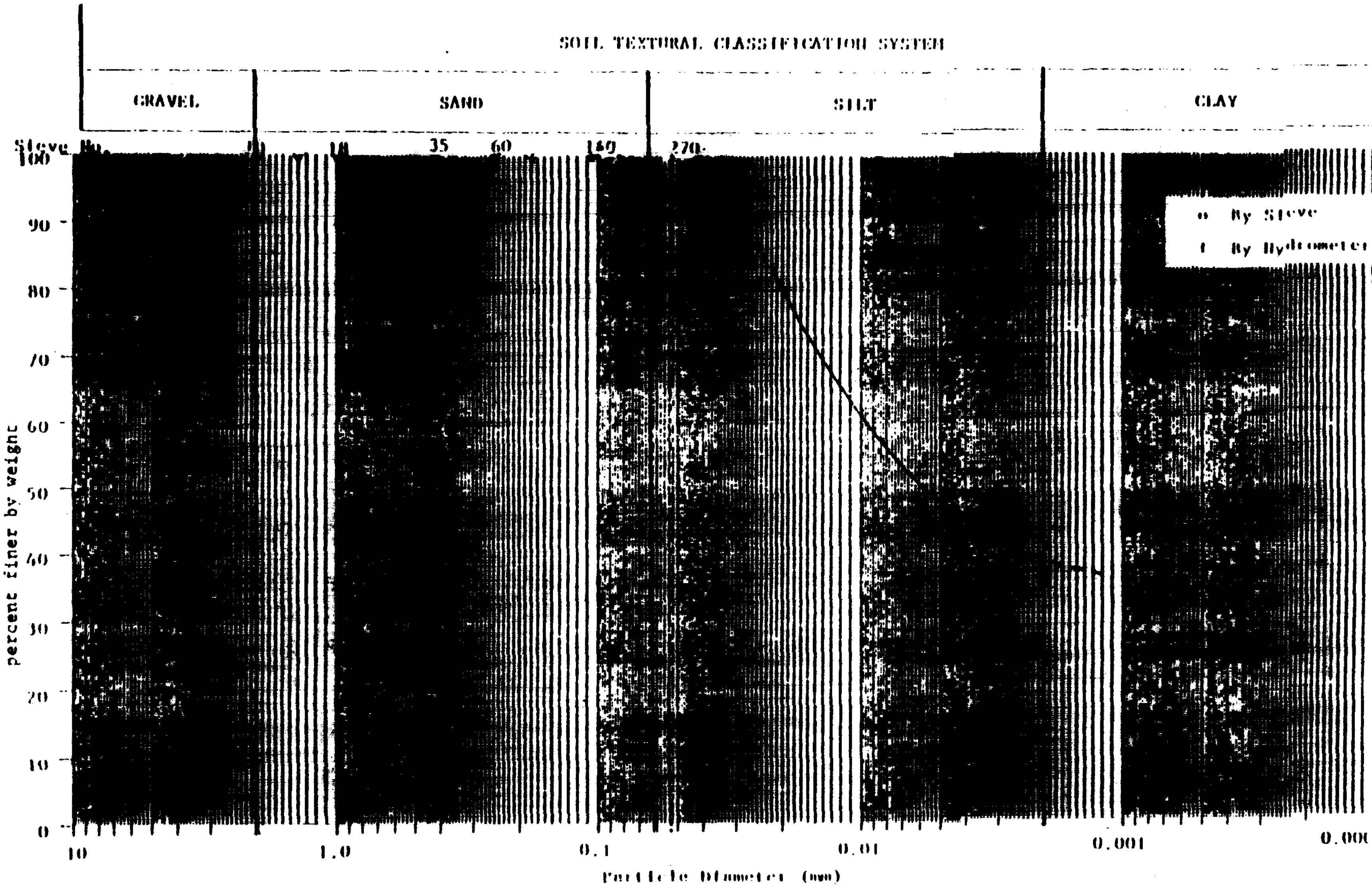
LPC 2 ...

recycled paper



Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Tested By ______

Illinois Environmental Protection Agency---DLS

% Gravel & Sand less than 15% % Silt 45.94 or more% Clay 39.06 Name: Clayey Silt

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24232

Date Collected 10/30/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

P-4, S-3, 2.0-3.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS

X SIEVE SIZE ANALYSIS

___ UNDISTURBED PERMEABILITY

___ DISTURBED PERMEABILITY

___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

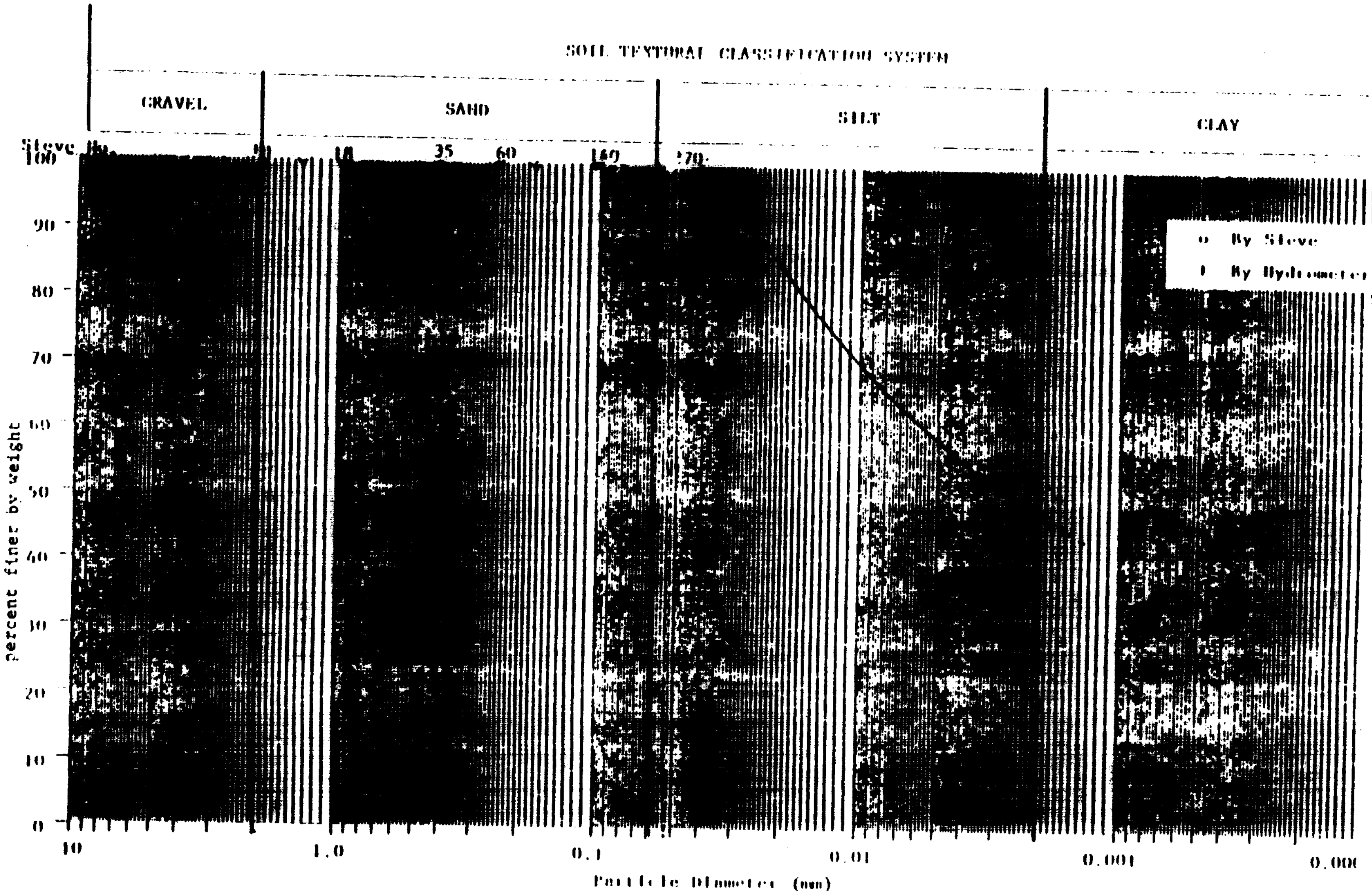
permeablilty:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	NA	5.0	.0209	85.28
18	1.00	Less than	20.0	.0099	70.15
35	.417	15% of	60.0	.0056	61.90
60	.250	sample greater	240.	.0026	50.89
140	.105	than .053 mm.	360.	.0022	48.14
270	.053				
pan					

COMMENTS



Sample No. (Field) ________ Sample No. (Lab) ________ Date ________

Illinois Environmental Protection Agency DLS Tested By ________

% Gravel & Sand less than 15% % Silt 36.84 or more % Clay 48.14 Name: Silty Clay

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24233

Date Collected 10/30/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
P-4, S-4, 3.0-4.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

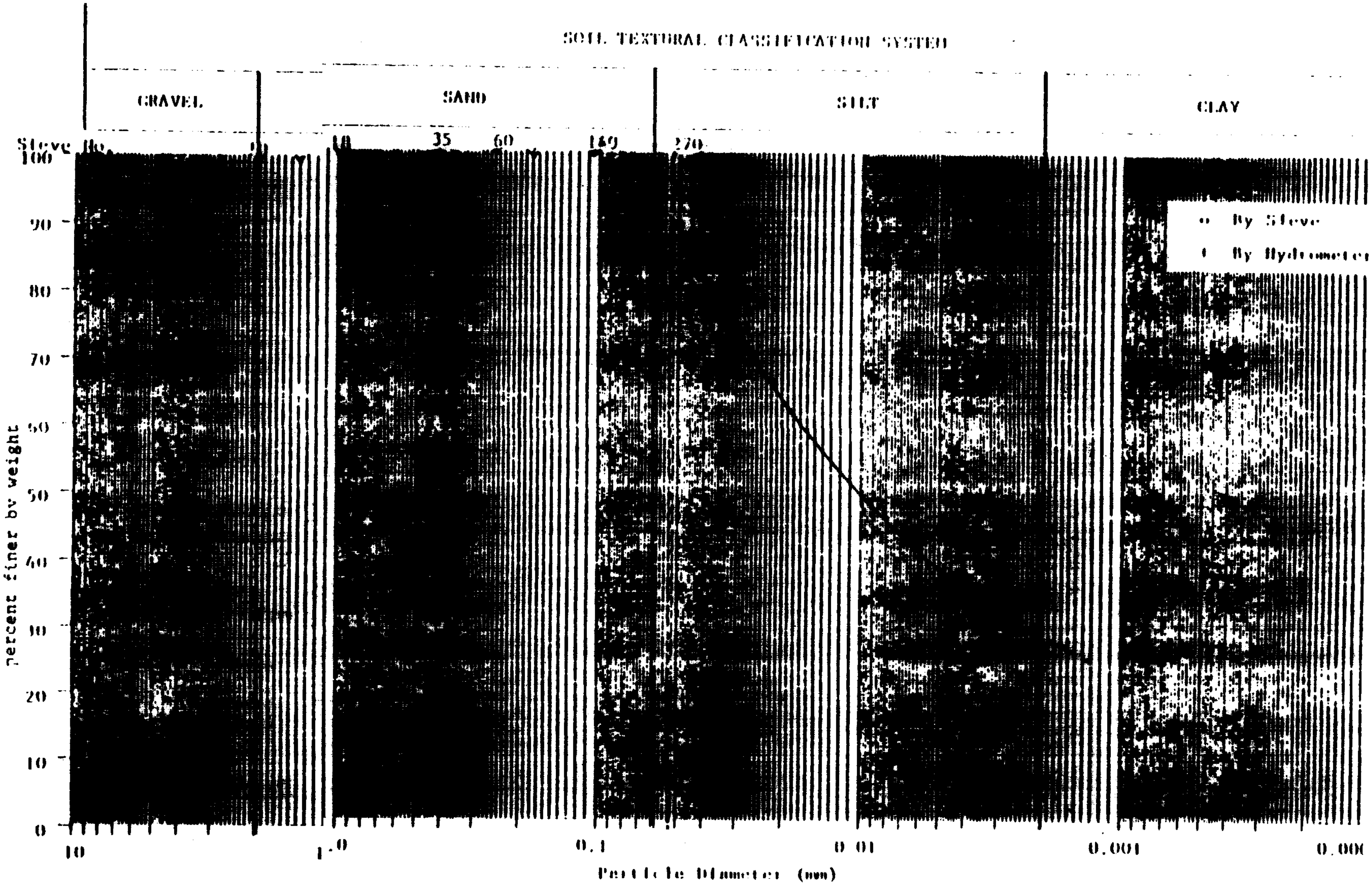
permeability:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	NA	5.0	.0212	65.66
18	1.00	Less than	20.0	.0091	46.35
35	.417	15% of	60.0	.0055	38.62
60	.250	sample greater	240.	.0027	30.90
140	.105	than .053 mm.	360.	.0022	28.97
270	.053				
pan					

COMMENTS



Sample No. (Field) ________ Sample No. (Lab.) ________ Date ________

Illinois Environmental Protection Agency---DLS

Tested By ________

% Gravel & Sand less than 15% % Silt 56.03 or more % Clay 28.97 Name: Clayey Silt

V-78

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______

Laboratory ID No. B 24234

Date Collected 10/30/80

Date Received Nov.14,1980

Division Program Code ______

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

P-4, S-5, 4.0-5.0

Physical Observations, Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ______

DATE ANALYSIS COMPLETED ______

DATE ANAYSIS REPORTED ______

TEST RESULTS

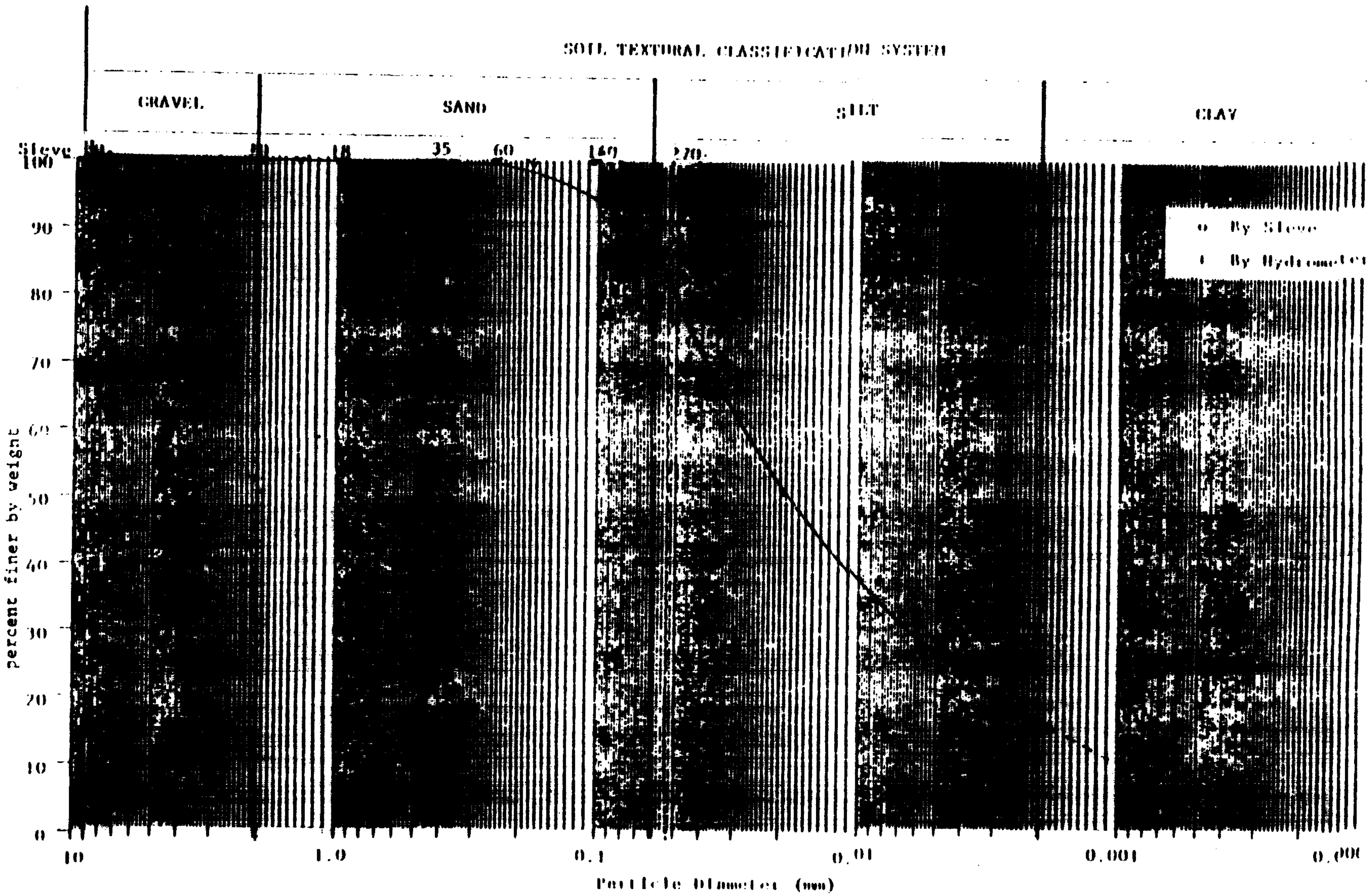
permeability:

______ cm/sec

grain size:

sieve no.	sieve opening (mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	100.00	5.0	.0187	50.08
18	1.00	99.86	20.0	.0083	32.91
35	.417	99.48	60.0	.0050	28.62
60	.250	98.48	240.	.0025	22.90
140	.105	95.82	360.	.0019	14.31
270	.053	82.05			
pan					

COMMENTS



Sample No. (Field) ____________ Sample No. (Lab.) ____________ Date ____________

Illinois Environmental Protection Agency---DLS

Tested By ________

% Gravel 0 % Sand 13 % Silt 77.69 % Clay 14.31 Name: Sandy, Clayey, Silt

V-7

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ____________ Laboratory ID No. B 24235

Date Collected 10/30/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)

P-4, S-6, 5.0-6.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
__ UNDISTURBED PERMEABILITY
__ DISTURBED PERMEABILITY
__ OTHER ____________

DATE ANALYSIS COMPLETED ____________

DATE ANAYSIS REPORTED ____________

TEST RESULTS

permeability:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	99.98	5.0	.0200	38.55
18	1.00	99.88	20.0	.0086	24.19
35	.417	99.61	60.0	.0052	20.41
60	.250	98.98	240.	.0025	16.63
140	.105	97.15	360.	.0021	15.87
270	.053	80.35			
pan					

COMMENTS

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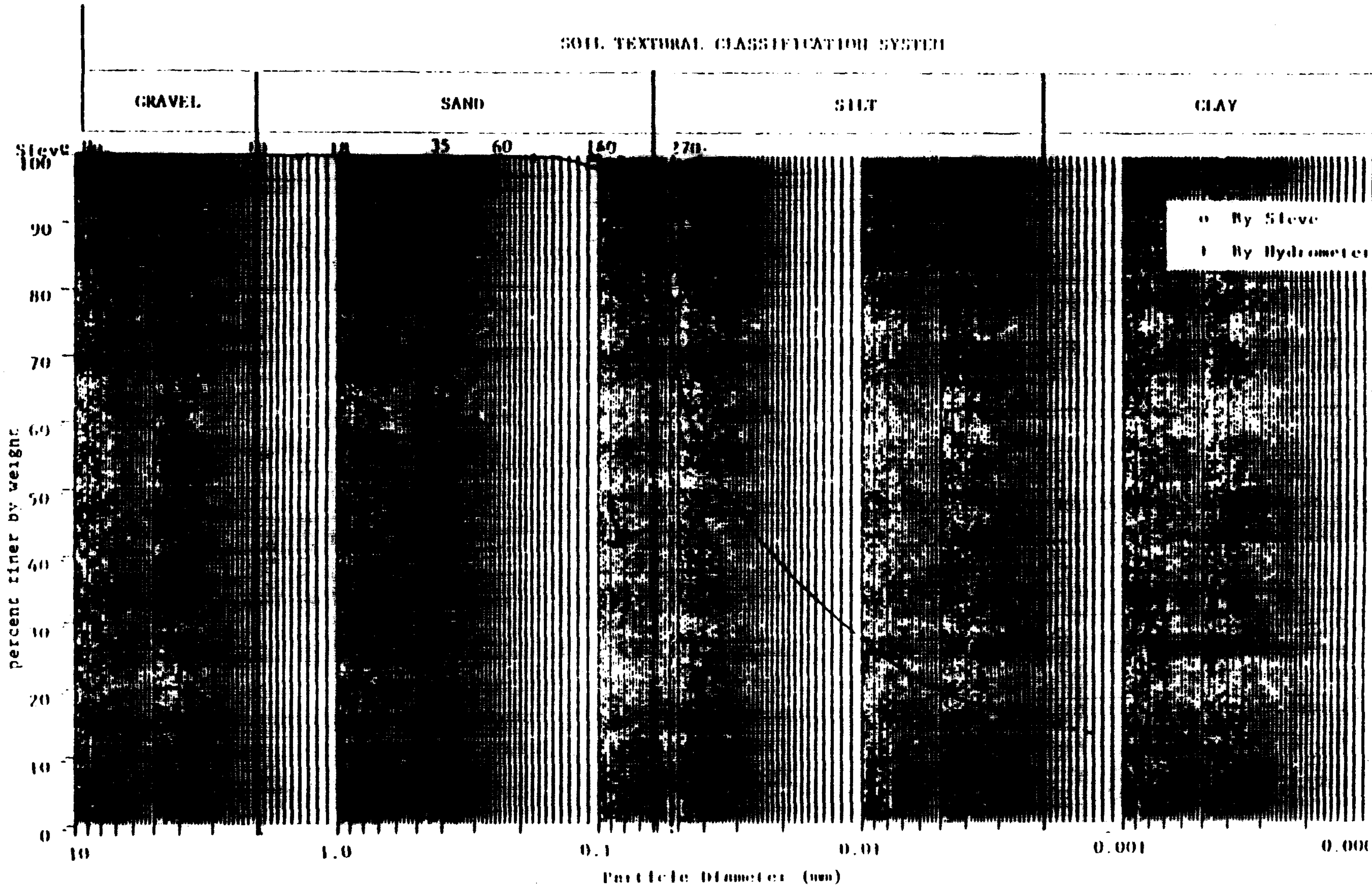


Sample No. (Field) ______ Sample No. (Lab.) ______ Date ______

Tested By ______

Illinois Environmental Protection Agency---DLS

% Gravel .02 % Sand 12 % Silt 72.11 % Clay 15.87 Name: Sandy Clayey, Silt

ILLINIOS ENVIRONMENTAL PROTECTION AGENCY - Division of Land/Noise Pollution

Time Collected ______________ Laboratory ID No. B 24236

Date Collected 10/30/80 Date Received Nov.14,1980

Division Program Code ________

County	File Heading	File Number
St. Clair	Dead Creek/Cahokia	

Source of Sample (boring number, sample number, depth interval in feet)
P-4, S-7, 6.0-7.0

Physical Observations,Remarks

TESTS REQUESTED

X HYDROMETER SIZE ANALYSIS
X SIEVE SIZE ANALYSIS
___ UNDISTURBED PERMEABILITY
___ DISTURBED PERMEABILITY
___ OTHER ______________

DATE ANALYSIS COMPLETED ________

DATE ANAYSIS REPORTED ________

TEST RESULTS

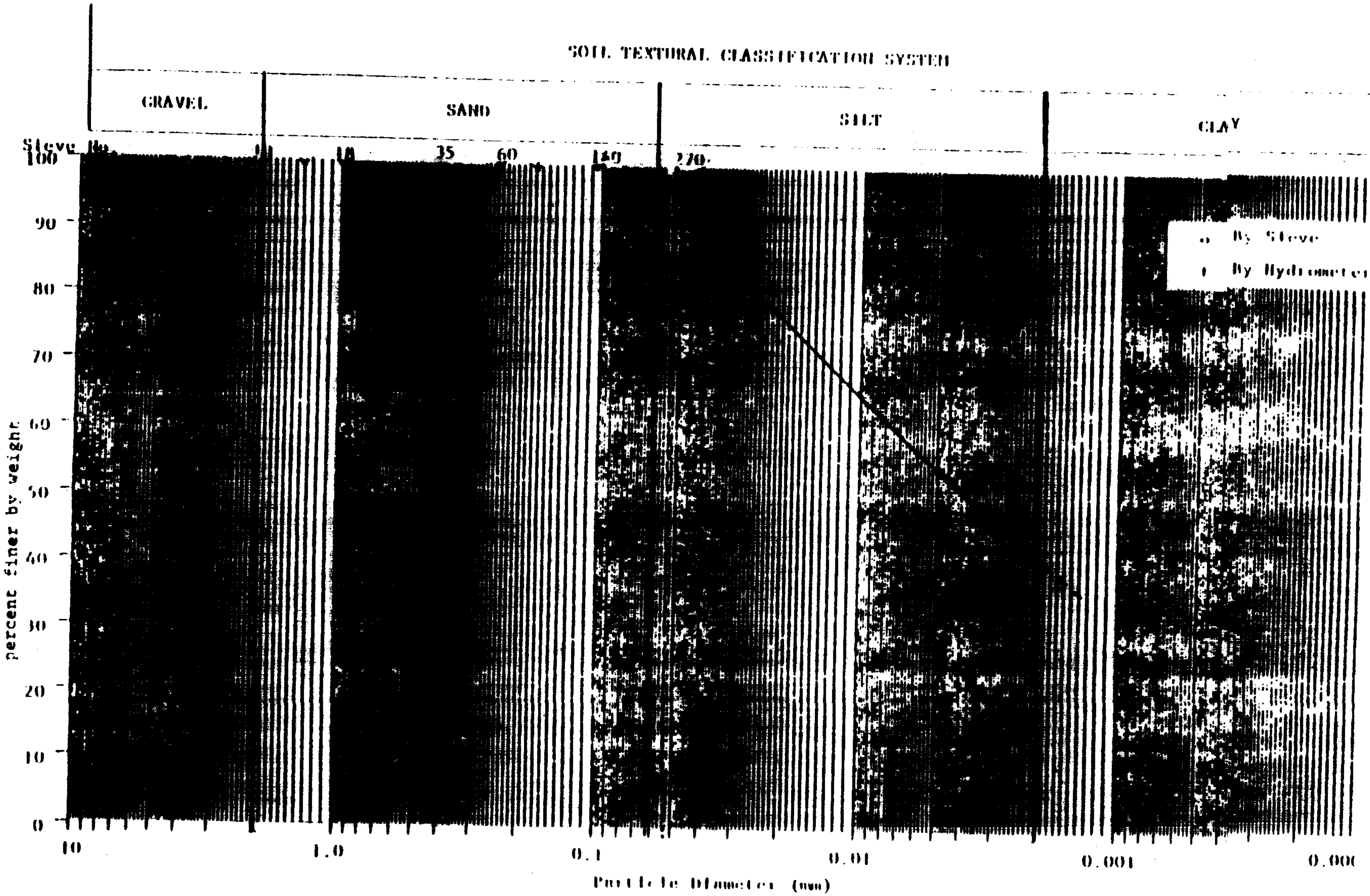
permeabilitv:

________ cm/sec

grain size:

sieve no.	sieve opening(mm)	P, percent of sample finer	time (min)	particle size, D(mm)	P, % remaining in solution
10	2.00	NA	5.0	.0222	79.14
18	1.00	Less than	20.0	.0101	67.55
35	.417	15% of	60.0	.0060	57.90
60	.250	sample greater	240.	.0029	47.29
140	.105	than .053 mm.	360.	.0023	44.39
270	.053				
pan					

COMMENTS



Sample No. (Field) ______________ Sample No (Lab.) __ Date ______

Illinois Environmental Protection Agency---DLS Tested By

% Gravel& Sand less than 15% % Silt 40.0 or more % Clay 42.0 Name: Silty Clay

V-78

Appendix 3 - Geophysical Equipment

Equipment Specifications

Two forms of seismic equipment were tried in the study area. A Geospace GT2B 12 channel portable refraction unit, utilizing plastic explosives, and a Bison 1570A signal enhancement seismic unit were used in an attempt to locate the position, size, and depth of the former sand pits in the area. Neither unit was successful as there was too much interference in the area caused by industry and traffic.

Information pertaining to the metal detector used appears in Figure A-2.

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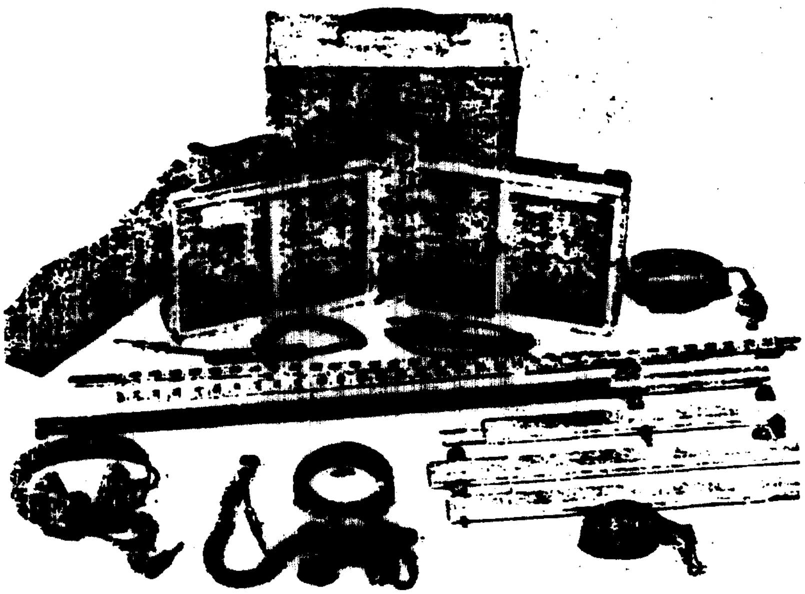
ecology and environment

FISHER'S M-Scope Model TW-5

PIPE and CABLE LOCATOR



FEATURES

- Auto-Sensitivity Meter
- Discriminator circuit eliminates outside interference, such as 60-Hz signals
- Three operating modes: Inductive Location, Inductive Tracing, and Conductive Tracing
- Wide scope of applications: the TW-5 locates, traces, pinpoints, and determines depth
- Easy and accurate depth measurement thanks to 45° bull's-eye level built into the control housing; even greater accuracy using the tracer probe
- All solid-state circuitry
- Field-proven reliability
- Moisture-resistant
- Built-in Loudspeaker
- 5-Year Limited Gold Seal Warranty

fisher M-SCOPE

FRL, INC. a subsidiary of Cohu, Inc.

 Figure A-2. Metal detector specifications

recycled paper

ecology and environment

APPENDIX B

SAMPLING PLAN FOR THE DEAD CREEK PROJECT

February 1986

Prepared for:

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF LAND POLLUTION
2200 CHURCHILL ROAD
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1. SCOPE/OBJECTIVES

This sampling plan has been prepared by Ecology and Environment, Inc., (E & E) for the Illinois Environmental Protection Agency (IEPA) for the Remedial Investigation (RI) at the Dead Creek Project in the towns of Sauget and Cahokia, Illinois. The objective of the sampling is to define the nature and extent of contamination of the Dead Creek Project area by investigating air quality, surface and subsurface soils, and groundwater, as well as surface water and sediments in Dead Creek. Sampling will be conducted in 18 areas: six sectors of Dead Creek, designated A through F, and 12 sites, designated G through R. The analytical data resulting from the RI will be used to prepare a Feasibility Study (FS) to determine if remedial actions are necessary and what level and types of actions are required to mitigate the contamination.

The purpose of the <u>surface soil sampling</u> is to:

- Define the overall extent of surface contamination;
- Describe and categorize contaminant types;
- Locate and define "hot spot" areas of contamination; and
- Provide data to estimate quantities of contaminated soil which require remedial action.

The purpose of the <u>subsurface soil sampling</u> is to:

- Locate and investigate subsurface areas containing hazardous materials, including areas which may have received bulk solid or liquid wastes in addition to containerized wastes;

- Identify and categorize waste materials which are detected; and

- Estimate quantities of waste requiring remedial activities.

The purpose of the groundwater sampling, which will involve the sampling of both existing and newly installed wells, is to:

- Provide groundwater quality data;
- Identify contaminants; and
- Determine the extent and location of contaminated plume(s).

The purpose of the surface water and sediment sampling is to:

- Assist in defining surface water drainage patterns;

- Assist in determining rates of runoff and infiltration in the area;

- Determine types of contaminants in surface water and sediments and possible sources, including:

  - Surface runoff,
  - Solubilization of substrate contaminants, and
  - Groundwater, and

- Provide data to estimate quantity of water and sediment which requires remediation.

In addition to the above activities, soil gas surveys and air quality investigations will be conducted as necessary. The purpose of the soil gas survey is to aid in the identification and definition of any contaminated plume or contaminant "hot spots." Air quality investigations will aid in the characterization of air contaminants and will include both ambient air characterization and investigation of point source air releases.

2. SAMPLING LOCATIONS

Samples to be collected from the Dead Creek Project sites include:

- Surface soil samples;
- Subsurface soil samples (from borings);
- Groundwater samples; and
- Surface water/sediment samples.

In addition, air quality investigations will be conducted on a routine basis during on-site work. Soil gas measurements will be taken as necessary, but will not exceed 96 specific locations.

Table 2-1 provides a summary of the number of samples to be collected for each of the various sample media, at the various sites. The site locations are shown on Figure 2-1. Individual site maps are presented in Section 10, at the end of this document.

2.1 AIR INVESTIGATION

The air investigation will consist of screening random points on each of the sites with an Organic Vapor Analyzer (OVA) or the HNu Photoionizer (HNu) to locate "hot spot" off-gassing and point source releases. Initially, an air survey will be conducted on-site prior to the start of operations to establish a baseline. Then, air quality investigations will be conducted when on-site work, such as drilling, soil gas surveys, soil sampling, etc., is in progress. An OVA will be utilized to determine the concentration of organic vapors present in

Table 2-1

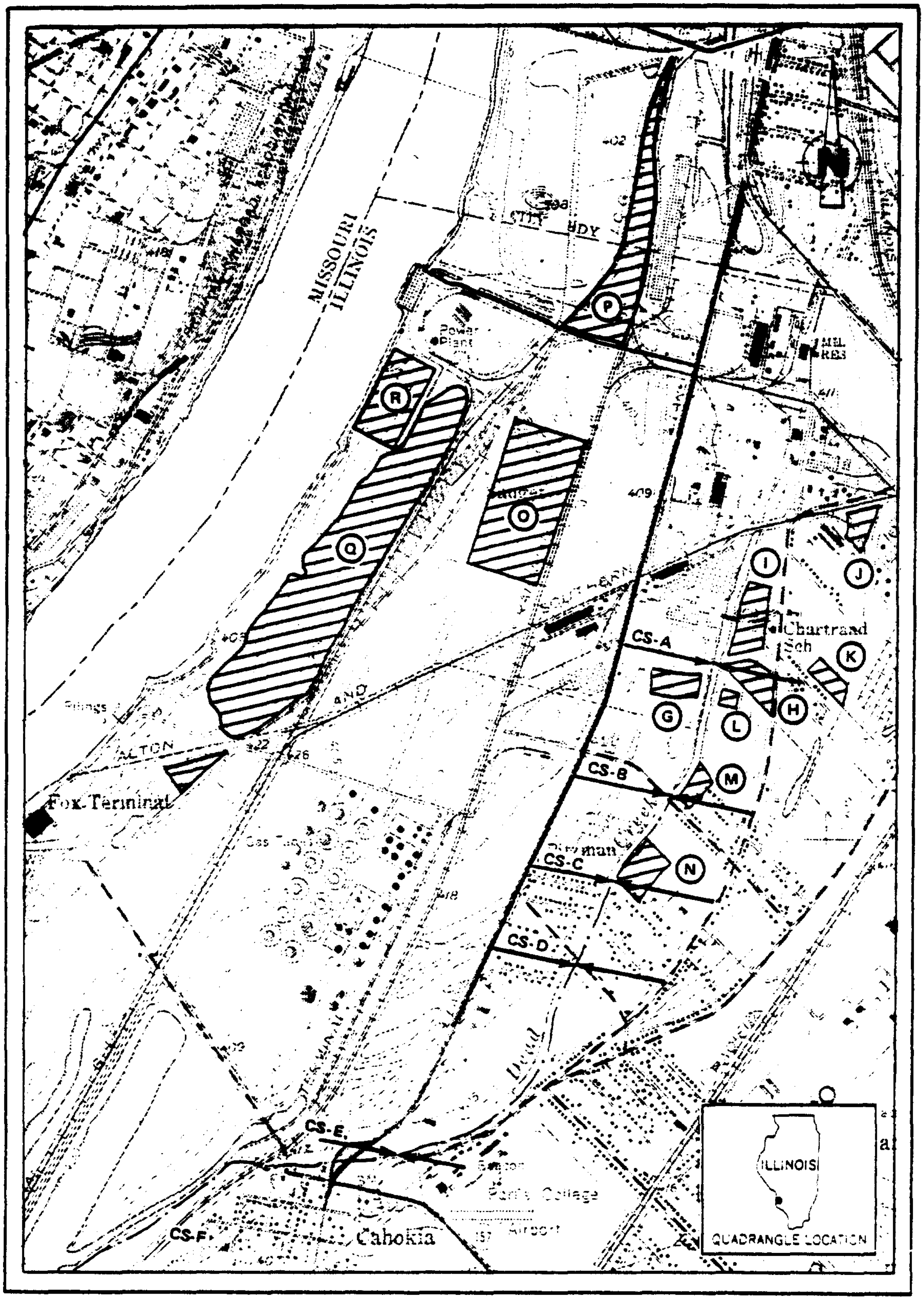
DEAD CREEK PROJECT SAMPLING FOR VARIOUS MEDIA

Sample Medium	Site	Sample Matrix	Number of Samples	Comments
Surface water/sediment	A	Water	3	Grab and composite
" "	B	"	3	" "
" "	C	Water/sediment	2/2	" "
" "	D	" "	1/2	" "
" "	E	" "	3/10	" "
" "	F	" "	4/10	" "
" "	M	" "	2/3	" "
" "	Field QC samples*	" "	5/6	" "
Surface soil	G	Soil	40	Grid (50 foot)
" "	H	"	5	Random
" "	I	"	32	Grid (100 foot)
" "	J	"	5	Random
" "	N	"	3	"
" "	Field QC samples*	"	15	Random
" "	To be determined	"	10	Dioxin
Subsurface soil	G	Soil	10	Composite
" "	H	"	5	"
" "	I	"	15	"
" "	J	"	5	"
" "	K	"	3	"
" "	L	"	4	"
" "	N	"	2	"
" "	Field QC samples*	"	12	"
Groundwater	Existing monitoring wells	Water	12**	Assigned wells
"	Existing residential wells	"	5	" "
"	New monitoring wells	"	20	" "
"	Field QC samples for wells*	"	8	
Total Samples			199 soil/sediment 68 water 96 soil gas***	

*Field QC samples include one duplicate per 10 samples and one blank per day or per shipment if more than one shipment is made per day.

**Actual number of samples to be determined. Only 8 of 12 existing wells have been located. All wells need to be reconstructed prior to sampling.

***See Section 2.6 Soil Gas Survey for specific locations.



SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 2–1 DEAD CREEK PROJECT AREA SITE LOCATION MAP

the breathing zone and in the soil. Parameter air sampling using the OVA will be performed once every two hours down range from the work station to determine if any volatile organics are leaving the site at elevated levels.

2.2 SURFACE SOIL SAMPLING

Surface soil sampling will be performed in site areas G, H, I, J, and N. Sites H, J, and N will be sampled at random locations to be determined in the field (e.g., samples will be taken in areas where stains or other signs of contamination are present). Some samples will be field composited; field screening measurements will be obtained using an OVA and HNu. A total of 13 samples will be analyzed from these three sites. Notes on sampling activities, including how the samples obtained represent site conditions, will be recorded in a field log.

Sites G and I have been designated for grid sampling, per the IEPA scope of work. Data from the grid sampling will be plotted and contoured on a site base map. Initially, a grid will be staked out on the surface using common surveying and measuring techniques. Site G will be sampled at 50-foot intervals resulting in 74 sampling points and Site I will be sampled at 100-foot intervals resulting in 56 sampling points. Grids will be sampled by selecting as a minimum 3 subsamples to represent each grid section. Subsamples will be collected using a coring tool. These samples will then be composited (see sampling procedures section) into one sample per grid section. After this sample is collected, it will be screened with an OVA or HNu. Finally, 40 samples will be selected from Site G and 32 samples will be selected from Site I for analysis. Data from the grid sampling will be plotted and contoured on a site base map. In addition, 10 soil samples will be collected for dioxin analysis at the direction of and at locations selected by IEPA. A total of 100 surface soil samples will be collected and analyzed for all Hazardous Substance List (HSL) compounds as well as metals and cyanide (see Table 2-2). The HSL compounds include volatiles, semi-volatile (base/neutral and acid extractable) compounds, and pesticides/PCBs. Ten soil samples will be analyzed for 2,3,7,8-TCDD at the direction of IEPA. The 100 samples include 10% QC samples, consisting of one duplicate per 10

Table 2-2

ORGANIC AND INORGANIC PARAMETERS LIST

PRIORITY ORGANIC POLLUTANTS

Acid Compounds

2,4,6-trichlorophenol
p-chloro-m-cresol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-2-methylphenol
pentachlorophenol
phenol

Base/Neutral Compounds

acenaphthene
benzidine
1,2,4-trichlorobenzene
hexachlorobenzene
hexachloroethane
bis(2-chloroethyl)ether
2-chloronapthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis(2-chloroisopropyl)ether
bis(2-chloroethoxy)methane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
N-nitrosodiphenylamine

Base/Neutral Compounds (Cont.)

N-nitrosodipropylamine
bis(2-ethylhexyl)phthalate
benzyl butyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene
acenaphthylene
anthracene
benzo(g,h,i)perylene
fluorene
phenanthrene
dibenzo(a,h)anthracene
indeno(1,2,3-c,d)pyrene
pyrene

Volatiles

benzene
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane
2-chloroethylvinyl ether
chloroform
1,1-dichloroethene
trans-1,2-dichloroethene
1,2-dichloropropane
trans-1,3-dichloropropene
cis-1,3-dichloropropene

Volatiles (Cont.)

ethylbenzene
methylene chloride
chloromethane
bromomethane
bromoform
bromodichloromethane
chlorodibromomethane
tetrachloroethene
toluene
trichloroethene
vinyl chloride

Pesticides

aldrin
dieldrin
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD
alpha-endosulfan
beta-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
alpha-BHC
beta-BHC
gamma-BHC
delta-BHC
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene

NON-PRIORITY ORGANIC POLLUTANTS

Acid Compounds

benzoic acid
2-methylphenol
3-methylphenol
4-methylphenol
2,4,5-trichlorophenol

Base/Neutral Compounds

aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnapthalene
2-nitroaniline
4-nitroaniline

Volatiles

acetone
2-butanone
carbondisulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
xylenes

INORGANICS

Aluminum
Chromium
Barium
Beryllium
Cobalt
Copper
Iron
Nickel
Manganese
Boron
Vanadium
Arsenic
Antimony
Selenium
Thallium
Mercury
Tin
Cadmium
Lead
Cyanide

samples and one blank per day. Surface soil samples indicative of background conditions will be collected as part of the site sampling load for comparison to samples obtained from suspected areas of contamination.

2.3 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling will be performed on seven sites: G, H, I, J, K, L, and N. The proposed sampling method involves the use of continuous split-spoon sampling to the maximum depth of each boring. The subsurface samples will be collected using 5-foot split spoons and augers. If field conditions prevent use of continuous sampling, 1.5-foot split spoons will be used to collect samples on an interval basis.

Sample locations will be chosen based on additional review of results of the geophysical study performed at sites G, H, and L, and on re-examination of historical aerial photography of sites I, J, K, and N. Split-spoon samples recovered will be screened with an OVA, and an HNu when necessary. Due to the limited number of samples allotted for subsurface sampling, samples will be composited.

At each boring, individual core samples will be composited, representatively sampled, placed in sample jars, and sealed. If interval samples are collected, these will be screened with an OVA, composited, representatively sampled, placed in sample jars, and sealed. Again, all work will be done at the boring location as part of the logging and sampling program. Additional compositing may be performed on designated samples at the hotline. These composites will be prepared in the following manner:

- Samples will be visually inspected and screened with an OVA or HNu.

- Samples will be composited from individual boreholes, based on the OVA/HNu scan. Where one sample per boring is being analyzed, the subsamples will be composited by mixing the most contaminated samples together. Where two samples per boring are to be analyzed, the most contaminated subsamples from above the water table will be composited, and the most contaminated samples from below the water table will be composited.

- To produce the composite, portions of several subsamples will be mixed together in a clean, decontaminated, stainless steel bowl using stainless steel tools.

- A representative portion of the resultant composite sample will be transferred to a clean sample jar and shipped for analysis.

A total of 56 subsurface soil samples will be collected and analyzed for HSL compounds, metals, and cyanide (see Table 2-2). The 56 samples will include 10% quality control samples, consisting of one duplicate per 10 samples and one blank per day. Blanks will be prepared using known control samples. When necessary to determine background levels, samples indicative of background quality will be collected as part of the site sampling load.

The following briefly describes the subsurface sampling at each of the seven sites.

Site G

Ten composite subsurface samples will be collected from Site G. Review of geophysical data indicates that the area between Queeny Avenue and a cultivated field approximately 300 feet south of Queeny Avenue has been backfilled and that large amounts of metal scrap are strewn throughout the area. In addition, numerous drums in various stages of deterioration have been noted on the surface.

As many as eight borings will be drilled to a maximum depth of 20 feet. Borings will be continuously sampled unless otherwise determined in the field. Field screening using an OVA and an HNu will be conducted when necessary.

Site H

Five composite subsurface samples will be collected at Site H. Review of geophysical data indicates that at least two and possibly three separate areas may contain drummed wastes. Initially, up to five borings will be drilled to a maximum depth of 50 feet. Borings will be continuously sampled unless otherwise determined in the field. Samples will be field-screened using an OVA and an HNu when deemed necessary. Five composite samples will be collected for analysis.

Site I

Fifteen composite subsurface soil samples will be collected at Site I. Approximately three borings will be drilled in the northern half of the site and up to six will be drilled in the southern half of the filled area. Maximum depth of the borings will be 40 feet. Borings may be shallower, depending upon visual inspection of the sample for staining and other field conditions. Final boring locations will be chosen based upon re-examination of historical aerial photos, additional review of existing file data, and defining the location of any buried utilities. Continuous samples will be collected, unless field conditions prevent such sampling. Fifteen composite samples will be submitted for analysis.

Site J

Five composite subsurface soil samples will be collected at Site J. As many as five borings will be drilled to a maximum depth of 20 feet. Shallower borings may result if field conditions warrant. Borings will be continuously sampled, unless field conditions prevent this. Samples will be field-screened with an OVA and HNu when deemed necessary.

Site K

Three composite subsurface soil samples will be collected from Site K. Three borings will be drilled to a maximum depth of 30 feet. Borings may be stopped at shallower depths if field conditions warrant. Final boring locations will be determined based upon locating buried utilities and defining property ownership. However, one boring is slated for each third of the site. Borings will be continuously sampled unless field conditions prevent it. Samples will be screened in the field using an OVA and HNu when deemed necessary.

Site L

Four composite subsurface soil samples will be collected from Site L. The geophysical investigation indicates isolated magnetic anomalies between the stored equipment and the area to the southeast of the former lagoon which is suspected to have been used for disposal of liquids. The electromagnetic (EM) conductivity study showed a high-intensity anomaly to the southeast of this same area. Four borings will be drilled at this site. Borings will be continuously sampled, unless field conditions prevent this. Total maximum depth of the borings will be 20 feet. Shallower borings will be made if the limit of contaminant penetration is determined at a shallower depth. Samples will be field-screened using an OVA or HNu when necessary.

Site N

Two composite subsurface samples will be collected from Site N. Two borings will be drilled to a maximum of 50 feet, unless field conditions prevent drilling to this depth. Boring locations will be determined after field inspection. Historical aerial photographs suggest the placement of one boring each in the southeast and the northwest portions of the filled area. Unless prevented by field conditions, continuous samples will be collected to completion depth. Samples will be screened in the field with an OVA or HNu when determined necessary.

2.4 GROUNDWATER SAMPLING

The proposed scope of work calls for the collection of groundwater samples from 12 existing monitoring wells, 5 existing residential wells, and 20 new monitoring wells (to be installed). However, only 8 of the 12 monitoring wells supposedly in existence have been located, and these 8 wells consist of hacksaw-slotted glue-joint PVC casing and will have to be reconstructed prior to sampling.

Measurements of groundwater levels and total well depth will be recorded before these samples are collected. All recorded data will be used to define groundwater level fluctuation and flow patterns in the area. Groundwater contour maps will also be generated from the hydrologic data. Field measurements of pH, temperature, and conductivity will be taken during sampling.

At least 10% of the samples will be collected in duplicate as field quality control samples. Field blanks will be furnished at one per day or one per shipment if more than one shipment is made in a day. A total of 45 samples (pending a determination by IEPA concerning the existing wells), including quality control samples, will be collected and analyzed for all HSL compounds, metals, and cyanide.

2.5 SURFACE WATER/SEDIMENT SAMPLING

Twenty-three surface water and 33 water sediment samples (including QC samples) will be collected from Creek Sectors A, B, C, D, E, and F, and Site M. Composite samples may be collected for both surface water and sediments within each site location. All composite or grab samples will be designated as such. All surface water and water sediment samples will be analyzed for HSL compounds, metals, and cyanide (see Table 2-2). All surface water samples will be field tested for pH, temperature, and conductivity. The following describes the sample locations at each site.

Creek Sector A

Three composite water samples will be collected from Creek Sector A. Samples will be collected from different depths and different locations along each of three profiles, one upstream, one midstream, and one downstream. A composite will be made for each profile.

Creek Sector B

Three composite water samples will be collected from Creek Sector B. Sampling will be performed as described for Creek Sector A.

Creek Sector C

Water samples will be collected from different depths and different locations from upstream and downstream profiles in Creek Sector C. A composite will be made for each profile. Sediment samples will also be collected from 1-foot cores from three locations on each profile, and a composite made for each profile.

Creek Sector D

One composite water sample will be collected from a downstream profile in Creek Sector D. Sampling will be performed as described for Creek Sector C. Two composite sediment samples will be collected from upstream and downstream profiles, as described for Creek Sector C.

Creek Sector E

Composite water samples and composite sediment samples will be taken from three profiles (one from each) one upstream, one midstream, and one downstream in Creek Sector E. Water samples will be collected and composited as for Sector A. Sediment samples will be collected and composited as for Sector C. Seven additional sediment grab samples will be taken from points where surface drainage or effluent pipes discharge into the creek.

Creek Sector F

Currently, IEPA wishes to defer sampling Creek Sector F pending results from the sampling at Creek Sector E. If Creek Sector E shows contaminants in the downstream area, sampling will be scheduled in Creek Sector F. If Creek Sector F is sampled, it will be done in the same manner as Creek Sector E.

Site M

Two water samples and three sediment samples will be collected from Site M. This site is an abandoned materials pit located adjacent to the creek. Depth, temperature, conductivity, and pH of the pond will be measured in the field. Two composite water samples will be collected using a Kemmerer bottle or negative/positive pressure sampling device. Three random sediment samples will be collected from the northwest, southwest, and east-central portions of the pond. Sediment sampling will be conducted using a Peterson steel dredge. This sampling may require a boat.

2.6 SOIL GAS SURVEY

The soil gas monitoring (SGM) survey will be conducted at 96 locations, in the sequence presented below. The number of locations to be sampled during each sequence is indicated in parentheses.

- Dead Creek area south of Queeny Avenue: Sites H and L on the east side of the Creek, and Site G on the west side of the creek (32 locations);

- Site M (6 locations);

- Site N (12 locations);

- Along the banks of sections of Dead Creek (Sectors A through E) (10 locations);

- Site K (6 locations);

- Site J (10 locations); and

- Site I (20 locations).

3. SAMPLING PROCEDURES

3.1 AIR INVESTIGATION

The air investigation will include:

- Surveying of sites for "hot spot" off-gassing;
- Identifying and quantifying air releases; and
- Determining background contaminant levels.

The air investigation will include two phases: preliminary source identification and remedial air investigation.

A meteorological station will be set up prior to on-site work to provide baseline data concerning wind direction and speed. This information will be used to determine locations for perimeter monitoring. A baseline volatile organic vapor survey will be conducted on the site prior to any sampling effort to identify areas where potential air problems may exist.

Each site then will be surveyed with an HNu, OVA, or other monitoring equipment. Instrument readings will be recorded for subsequent review and analysis. During this baseline survey, the presence and location of any staining on the ground or exposed waste materials will also be noted and recorded in the field logbooks. An assessment of the vegetative cover on each site will also be made to assist in the planning of additional particulate studies. OVA and HNu values will be recorded for further evaluation.

To achieve the optimum level for the presence of volatile organics in the air, the baseline volatile organic vapor survey should be conducted when ambient air conditions would provide the highest levels. Best results will occur when the air temperature exceeds 80°F and the wind speed is below five miles per hour (mph). Additionally, this baseline survey should be preceded by at least several days of warm weather. Upon completion of this baseline survey, the data will be reviewed with respect to historical information collected regarding waste types and disposal practices.

After all the sites have been surveyed, additional work may be scheduled for those sites demonstrating contaminant air releases. This will entail quantifying and qualifying the exact nature of contaminants being released. High-volume particulate samplers (for detecting metals and low or semi-volatile organic compound contaminants) and Tenax tube collectors (for detecting volatile contaminants) will be set up in at least one upwind and two downwind locations from each area to be investigated. Several additional stations may be distributed to identify base levels of contaminants. High-volume filters and Tenax tubes will be shipped to E & E's Analytical Services Center (ASC) for analysis.

Additional air monitoring data can be inferred from the soil gas monitoring investigation. In this study, volatile substances are traced in the vadose zone. Data from this study can be extrapolated to indicate areas of probable emission of contaminants to the air through natural volatilization.

3.2 SURFACE SOIL SAMPLING

Surface soil samples will be collected according to the procedures described below:

- Samples will be collected to a depth not to exceed 1 foot.
- Using a stainless steel coring device, soil samples will be collected from the ground surface.
- The samples will be transferred to an 8-ounce wide-mouth glass container. As many scoops as necessary will be taken until the sampling bottle is filled.

2. PROJECT BACKGROUND

2.1 PROJECT AREA DESCRIPTION AND HISTORY

The Sauget sites project area includes six segments of Dead Creek, an intermittent stream, and 12 sites in the towns of Sauget and Cahokia, St. Clair County, Illinois. Figure 1-1 shows the sites and the segments of Dead Creek. Each site or creek segment has been assigned an alphabetical designation. Individual site maps are included in Appendix G.

The history of the project area is not completely documented, but will be investigated as part of the RI/FS. However, some existing data concerning the area have been reviewed and are summarized herein. These data also were used in the development of the Work Plan. One data source evaluated was the IEPA report "A Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vicinity" (April 1981, known as the St. John Report). Relevant portions of this report are provided as Appendix A. Other sources evaluated include:

- All existing file data from IEPA central and regional offices (Divisions of Air, Water Pollution, and Land Pollution);
- File data from the state Attorney General's office, Springfield, Illinois;
- United States Environmental Protection Agency (USEPA) file data (Divisions of Enforcement, Water Quality, and Air);

- Illinois State Geological Survey published and open-file reports;

- Illinois State Water Survey published and open-file reports; and

- U.S. Army Corps of Engineers (St. Louis Regional Office) published reports and open-file data.

A number of locations within the project area were initially developed as sand pits (Sites G, H, I, and M) and the excavations were subsequently filled in with a variety of unknown materials, including wastes from sources in the towns of Sauget, Cahokia, and the East St. Louis area. According to the St. John report, the contamination of Dead Creek was likely due to tank truck residues and washout materials that were discharged by Harold Waggoner Trucking Company, and subsequently, Ruan Trucking Company. Other potential sources of contamination in Dead Creek include the following:

- Discharges from the Midwest Rubber Company, whose effluent pipeline led from their factory to the creek. This pipeline was removed sometime in the mid-1960s.

- Discharges from the holding ponds at Cerro Copper Products Company (Cerro Copper). Prior to the sealing of a culvert beneath Queeny Avenue, these ponds were headwaters for Dead Creek. At that time, the ponds received discharges from Cerro Copper and Monsanto Chemical Company (Monsanto).

- Groundwater discharges from past disposal pits/landfills in the vicinity of the creek.

The IEPA became aware of the project area in May 1980 as a result of a problem with periodic smoldering of materials in a ditch (Dead Creek). The problem did not appear to be serious until, in August 1980, a local resident's dog, after rolling in the ditch, died of apparent chemical burns. IEPA subsequently performed preliminary soil and water sampling to determine conditions in the ditch. The soil in the ditch was found to contain high levels of phosphorus, heavy metals, and polychlorinated biphenyls (PCBs). As a result, the IEPA restricted access to the area. This involved the installation of 7,000 feet of snow fence around the ditch and the pond between Queeny Avenue and Judith Lane. According to IEPA, soils and groundwater were polluted in the area, and a detailed study would be needed to assess the extent of pollution.

A brief description and history of each of the sites and creek segments within the project area is provided below. The alphabetic site and creek segment designations used below will be used for all reports, maps, and other deliverables.

2.1.1 Dead Creek Sectors

Dead Creek flows southwest through the towns of Sauget and Cahokia and discharges into the Prairie DuPont floodway, which in turn discharges into the Cahokia Chute of the Mississippi River. In general, Dead Creek is a small (8 to 10 feet wide), intermittent stream which serves as a conduit for drainage from the American Bottoms Area in St. Clair County. The hydrology of the creek is not well-defined, and will be assessed in this project. Water depths in the creek vary, and are entirely dependent on seasonal fluctuations. Six segments of Dead Creek have been designated as part of the project. The creek segments are shown on Figure 1-1. These are defined as follows:

- Creek Sector A - Dead Creek north of Queeny Avenue;
- Creek Sector B - Dead Creek between Queeny Avenue and Judith Lane;
- Creek Sector C - Dead Creek between Judith Lane and Cahokia Street;
- Creek Sector D - Dead Creek between Cahokia Street and Jerome Lane;
- Creek Sector E - Dead Creek between Jerome Lane and the culvert north of Parks College; and

- Creek Sector F - Dead Creek south of the culvert at Parks College to the discharge point into Prairie DuPont floodway.

Creek Sector A consists of a dammed section of Dead Creek which has been used as holding ponds by Cerro Copper. Discharges to these ponds are presently limited to surface drainage and roof drainage. Discharges to groundwater via seepage, and possible loss of contents via leakage at the dam are believed to occur. Land use in the Creek Sector B area includes industry in the northern portion, and agricultural fields on both sides of the creek in the southern portion. The remainder of the creek flows through residential/commercial areas in the Town of Cahokia.

2.1.2 Terrestrial Sites

There are 12 terrestrial sites of known or suspected contamination within the project area. These sites have been classified alphabetically, G through R, and are briefly described below. The sites are shown on Figure 1-1.

Site G - IEPA Sites 1 and 2

The examination of historical photographs revealed that waste disposal operations at this site began in approximately 1955. Prior to that time, the area was used for agriculture. No information has been found concerning past operators or sources of disposal for this site. Drums containing a black cinder-like solid have been observed at the surface. Pits containing oily wastes have also been observed. In addition, the site has been used extensively for the surface disposal of general waste. Originally, IEPA Site 1 was considered to be the area of previous waste disposal; IEPA Site 2 was the surrounding area. However, since the area between the sides was undefined, the two were combined for purposes of the RI.

Site H - IEPA Sites 3 and 4

This site was a former sand and gravel pit which was filled with construction debris and other wastes. Monsanto notified USEPA in 1981 that drums of solvent, other organics, and inorganics were buried on-site. Waste disposal occurred on-site from about 1944 until 1957.

Prior to 1940, the Site H area was a cultivated agricultural field. The area contiguous to the site to the south is still used for agriculture. The initial purpose of excavation at Site H in the early 1940s was to obtain sand for the construction of roads, since wartime demand had significantly increased industrial activity in the area. Following World War II, surplus materials including chemicals and, reportedly, munitions were disposed of in excavated sand pits throughout the area. It is likely that municipal wastes from the towns of Sauget and Cahokia were also disposed of at Site H. The site has been covered, graded, and vegetated and is now inactive. Currently, the site is owned by Roger's Cartage Company. IEPA Site 3 was the actual disposal area and IEPA Site 4 was the surrounding area. Since there was no definite boundary between these IEPA sites, they were combined as Site H for the purposes of the RI.

Site I - IEPA Sites 5 and 6

The southern half of this site was contiguous with Site H until separated by the construction of Queeny Avenue. Disposal operations at Site I followed the historical progression as outlined above for Site H. Cerro Copper purchased property west of Site I in 1957 from the Lewin-Mathes Company. In approximately 1962, Cerro Copper added additional properties, including Site I, to their holdings. The site is presently covered with rip-rap and gravel, and is used by Cerro Copper for equipment storage. Creek Sector A is located immediately west of Site I on Cerro Copper property. Since the only differentiation between IEPA sites 5 and 6 was historical progression, they were combined as Site I for purposes of the RI.

Site J - IEPA Site 7

Site J consists of an unlined pit and a surface disposal area utilized by the Sterling Steel Foundry Company (Sterling). Sterling began operations at this location in approximately 1922. The surface disposal area occupies a triangular piece of Sterling Steel property covering approximately six acres to the northeast of the plant building. Examination of historical aerial photographs indicates disposal activity in this area began sometime between 1973 and 1978. Wastes disposed of at Site J include casting sand, demolition debris, and scrap metal. An unlined pit is located immediately south of the surface disposal area. Dimensions of this pit are roughly 50 feet x 50 feet. The pit was excavated in approximately 1950 for the purpose of collecting and allowing settlement of baghouse dust from the foundry furnace.

Additional areas of interest at Sterling Steel include a second unlined pit and an incinerator, which are not included in the scope of work for this project. The pit, located southeast of the plant building, was excavated in approximately 1955 as a borrow area for road construction material. The majority of the original excavation has since been filled with casting sand and scrap metal. The incinerator was used for burning plant trash from 1970 until approximately 1981.

Site K - IEPA Site 8

Historical photographs suggest possible waste disposal operations at this site. Excavation at the site began sometime in the late 1950s. No data have been generated for Site K. Since the excavation, the site has been covered and graded. At present, a trailer park and a small trucking company occupy the site.

Site L - IEPA Site 9

Historical photographs and IEPA file information indicate that a surface impoundment once existed at this site. Waggoner Trucking Company (Waggoner), an industrial waste hauler that specialized in hauling hazardous waste, used the site between 1964 and 1974 for washing trucks. Initially, the wash water was discharged to Dead Creek. Waggoner was ordered by the IEPA to cease discharging wash water to the creek in 1971. Subsequently, the surface impoundment was excavated for the purpose of "storing" the wash water. However, since the impoundment was not lined, this practice constituted disposal of liquids potentially containing hazardous constituents. Waggoner sold the property and operations to Ruan Trucking Company (Ruan) in 1974. Ruan reportedly continued to use the surface impoundment until 1978. Metro Construction Company (Metro) leased the property from Ruan in 1978 for the purpose of operating a heavy-equipment maintenance and repair shop. Metro subsequently purchased the property and covered the impoundment. Presently, the area is covered with cinders and is used for equipment storage.

Site M - IEPA Site 10

Site M consists of a former borrow pit which was used by the Hall Construction Company (Hall Construction). The pit is located immediately east of Dead Creek and contains water year-round. It is separated from the creek by a ridge. However, following heavy rains, overflow from the creek has been observed in the pit. The pit was excavated in the early 1950s, and was subsequently partially filled with unknown materials. A fence was installed around Site M concurrently with the restriction of access to Sector B of Dead Creek.

Site N - IEPA Site 11

Hall Construction occupies the Site N property. Examination of historical photographs indicates a possible disposal operation was conducted at this site between 1955 and 1968. No data have been generated, and IEPA has no file information concerning this site. The excavated area has since been filled with unknown materials. Presently, Hall Construction uses the property for equipment storage.

Site O - IEPA Site 12

Site O consists of four covered lagoons which were formerly used for sludge dewatering by the Sauget Wastewater Treatment Plant. This practice occurred from approximately 1968 to 1978. These lagoons cover about 22 acres to the south of the treatment plant. Over 90% of the influent to the plant is from Sauget area industries. Effluent from the treatment plant has exceeded permit limitations continuously since the early 1970s. Construction of a potable water line was initiated in 1983 in the area of the former lagoons. When workers complained of strong organic odors from excavations in the area, construction activity was halted, and the water line was subsequently rerouted. Presently, the lagoons are covered and vegetated, and an access road to the new American Bottoms Regional Treatment Plant has been constructed through the area.

Site P - IEPA Site 13

This site is an IEPA-permitted landfill. On several occasions between 1977 and 1981, IEPA inspectors noted hazardous waste disposal activities at the site in violation of the landfill permit. The wastes disposed of included empty drums with residues of Monsanto ACL-85; residues of phosphorus pentasulfide; and Monsanto ACL filter residue. A permit was issued by IEPA to dispose of diatomaceous earth filter cake from Edwin Cooper, Inc. (Ethyl Corporation). Reportedly, the ACL filter residue ignited when it came into contact with the diatomaceous earth filter cake. A highly permeable material which contains heavy metals was used for cover at the site. As a result, there is a potential for leaching of hazardous materials. The site is still permitted, but is presently inactive.

Site Q - IEPA Site 14

Site Q was an unpermitted landfill covering approximately 140 acres which reportedly accepted hazardous wastes. The site was operated by Sauget and Company between 1959 and 1973 as a municipal landfill. (Sauget and Company concurrently operates Site R, located immediately west of this site.) Inspection reports from health officials, and later the IEPA, cite violations during this period including lack of daily cover, open burning, and disposal of drummed waste at Site Q. The majority of the site has been covered with unsuitable material, including flyash and cinders. In 1980, workers uncovered buried drums in the northern portion of the site during construction of a railroad spur. Sampling in 1983 by the USEPA Field Investigation Team (FIT) indicated the presence of 63 of 117 priority pollutants in the subsurface soils at the site. Site Q is presently occupied by The Pillsbury Company, which operates a shipping and receiving facility.

Site R - IEPA Site 15

Site R is the Sauget Toxic Dump, which was used by Monsanto for the disposal of industrial wastes between 1957 and 1977. The site covers roughly 34 acres, and is located immediately west of Site Q, and approximately 150 feet east of the Mississippi River. Initially, disposal practices at Site R included the dumping of bulk liquids directly onto the ground. Reportedly, cinders were used as intermediate cover at the site. This is substantiated by pictures taken by IEPA during inspections of the facility. Drummed wastes were not segregated in any manner. A flood event was reported in 1973, at which time an earthen berm constructed to the west of the dump was washed out. The site has been extensively studied since its closure in 1977. A Monsanto feedstock tank farm is located adjacent to the site in the northwest corner. Presently the site is clay- capped and vegetated.

2.2 ENVIRONMENTAL SETTING

2.2.1 Geology

The Dead Creek project area is situated in the Mississippi River floodplain on valley deposits. The valley deposits consist of a thin mantle of Cahokia Alluvium, and thicker glacial outwash known as the Henry Formation.

The Cahokia Alluvium was derived from the erosion of till and loess, and consists of unconsolidated, poorly sorted silt with some local sand and clay lenses. In the Dead Creek area, the Cahokia Alluvium has a thickness ranging from 6 to 20 inches and a laboratory permeability on the order of 7×10^{-6} cm/sec. The Cahokia Alluvium rests uncomformably on the Mackinaw member of the Henry Formation. The Henry Formation is Wisconsin glacial outwash in the form of valley train deposits. It consists of a sequence of subrounded, moderately sorted sands and gravel, coarsening downwards. The Henry Formation has a thickness ranging from 100 to 114 feet and a laboratory permeability on the order of 4×10^{-3} cm/sec. Due to its thickness, permeability, and water capacity, the Henry Formation is a major aquifer for the East St. Louis area. The bedrock underlying the valley deposit is a limestone of Mississippian age (Figure 2-1).

2.2.2 Groundwater Occurrence

At most locations in the project area, Henry Formation sands, which rise to within 14 feet of the surface on the average, are the major aquifer. Exceptions occur in the northern and southern portions of the creek, where the silt mantle thickens and the groundwater level encounters it.

SYSTEM	SERIES	STAGE	FORMATION	COLUMN	THICKNESS (In Feet)	DESCRIPTION
QUATERNARY	PLEISTOCENE	HOLOCENE	CAHOKIA ALLUVIUM		6–20	SILT, LIGHT TAN, WITH CLAY AND FINE SAND LOCALLY, MICACEOUS.
		WISCONSINAN	HENRY		100–114	SAND, TAN, ARKOSIC, FINE GRAINED AT TOP COARSENING DOWNWARD TO INCLUDE SOME FINE TO MEDIUM GRAINED GRAVEL. SUBROUNDED, MODERATELY SORTED. CONTAINS: QUARTZ, CHERT, FELDSPARS, LIMESTONE, FERROMAGNESIAN MINERALS, SHELL FRAGMENTS; WOOD CHIPS AND COAL FRAGMENTS AT TOP.
		GROUP				
MISSISSIPPIAN	VALMEYERAN	MIDDLE VALMEYERAN			100+	LIMESTONE

Figure 2–1 GENERALIZED GEOLOGIC COLUMN FOR UNCONSOLIDATED DEPOSITS TO BEDROCK IN THE DEAD CREEK AREA

Water table conditions, as opposed to leaky artesian conditions, prevail at the site because the lower portion of the alluvial silt is permeable enough (5.4×10^{-3} cm/sec) not to impede vertical movement of the groundwater.

Potentiometric surface maps developed by the IEPA indicate that the hydraulic gradient is very flat in the project area. The gradient is 3 feet/1,060 feet, or .00283, generally moving to the west, but with local fluctuations apparent.

2.2.3 Climate

The project area is located in the northern temperate zone which is characterized by warm summers and moderately cold winters. The average annual precipitation in the area is about 38 inches, based on data from Edwardsville, Illinois. The greatest amounts of rainfall occur from March through June. Then a gradual monthly decline occurs until December. With the average calculated evapotranspiration calculated at about 33 inches, the average potential water surplus is about 5 inches a year. Some of this surplus water infiltrates the soil and moves downward.

2.3 PREVIOUS INVESTIGATIONS

Previous investigative activities in the project area have included sampling of groundwater, surface water, sediment, surface soil, subsurface soil, and air quality. These investigations include the following:

- IEPA - Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vicinity, April 1981 (described in the St. John Report).

- USEPA Field Investigation Team (FIT) - Soil Sample Results for Chemical Contamination Below Sauget/Sauget Landfill in Sauget, Illinois, December 16, 1983.

- IEPA - Illinois Air Quality Report, 1984, published in June 1985.

- Various IEPA open-file investigations, including analytical data and correspondence memoranda.

- USEPA Technical Assistance Team (TAT) data and memoranda concerning leachate sampling at the Sauget Toxic Landfill, November 1981.

The following sections briefly describe both the general (Section 2.3.1) and site-specific (Section 2.3.2) sampling and analytical work that has been conducted in the project area, and summarize the results of this work.

2.3.1 General Groundwater, Surface Water, and Air Quality Investigations

Groundwater

The 12 monitoring wells installed by the IEPA in 1980 were sampled twice during the IEPA Preliminary Hydrogeologic Investigation of Dead Creek and Vicinity (St. John Report, Appendix A). The locations of these wells are included in Appendix A, as are the analytical results. The St. John Report specifically studied the groundwater in the vicinity of Sites G, H, I, and L. In addition to these wells, four private wells off-site along with on-site Well G 108 were sampled to establish the background water quality. Water samples were collected and preserved according to IEPA standards; however, the samples were not filtered.

Inorganic chemical parameters, which were analyzed for background quality, indicated that iron, manganese, and phosphorus were generally above the state's water quality standards. Analysis of samples from these wells showed no organics above the detection limit of 1.0 part per billion (ppb).

The following is a summary of downgradient groundwater quality (as outlined in the St. John Report) for wells installed during the IEPA preliminary hydrogeologic investigation.

Concentrations of copper, iron, manganese, phosphorus, and residuals on evaporation (R.O.E.) in the downgradient wells exceeded the standards and background levels in every well. Lead, phenolics, sulfate, and zinc were above the standards in six or more wells.

PCBs were detected in three wells: G101, G102, and G110 (see Appendix A). Other organics detected, such as chlorophenol, chlorobenzene, dichlorobenzene, dichlorophenol, cyclohexanone, and chloroanilines, were mostly associated with wells G107 and G112, although some other organics were also found in wells G102, G109, and G110. All of these organics were found in relatively high concentrations and were not found in the background wells. The organic and inorganic analyses discussed above indicate groundwater pollution in the area from various sources.

Among the wells, it appears that the groundwater in Well G109 is the most polluted; ammonia, arsenic, cadmium, copper, iron, manganese, nickel, pH, phenols, phosphorus, R.O.E, sulfate, and zinc exceeded the water quality standards several times over. Other parameters for which no standards exist were found at high concentrations. This well is located between Dead Creek and the former disposal impoundment (Site L).

Two wells, G112 and G107, exhibited concentrations of metals substantially above the state water quality standards. These wells are located downgradient of Sites I and G, respectively. The highest concentrations of organics were also detected in samples from these wells. In G107, two samplings have shown that chlorophenol, chlorobenzene, dichlorobenzene, dichlorophenol, and chloroaniline are present. In G112, chlorobenzene, dichlorobenzene, and chloroaniline were detected. Other highly polluted wells include G110, G106, G105, G103, and G102 in which several inorganic parameters were found to exceed the background levels and the standards.

When compared to background levels, monitoring wells G101 and G104 indicate little evidence of pollution. This is probably due to the locations of the wells away from the pollution sources in the project area, and the attenuation of the chemicals over the long flow distance and time. Although Well G101 is located relatively close to the southwest corner of Site G (a distance of approximately 100 feet), both wells are located at least 400 feet from Dead Creek. Also, G101 and G104 are the only wells in the IEPA study which are located west of a large depressional area situated south of Site G. This area standards and background levels in every well. Lead, phenolics, sulfate, and zinc were above the standards in six or more wells.

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When compared to background levels, monitoring wells G101 and G104 indicate little evidence of pollution. This is probably due to the locations of the wells away from the pollution sources in the project area, and the attenuation of the chemicals over the long flow distance and time. Although Well G101 is located relatively close to the southwest corner of Site G (a distance of approximately 100 feet), both wells are located at least 400 feet from Dead Creek. Also, G101 and G104 are the only wells in the IEPA study which are located west of a large depressional area situated south of Site G. This area contains water during the majority of the year, possibly indicating groundwater discharge to the depression. This would reduce the likelihood of finding contaminants in these wells. Elevated levels of contaminants detected in Well G107, located immediately south of Site G in the depression, lends support to this possibility.

In addition to the preliminary hydrogeological investigation in the vicinity of Dead Creek, the IEPA has sampled monitoring wells at Site R which were installed by a contractor for Monsanto. The locations of these wells are shown on Figure 2-2, and the analytical results are presented in Tables 2-1 and 2-2. These results indicate the presence of high levels of organic contaminants in all wells sampled in 1979 and 1981. Organic contaminants detected include biphenylamine, chlorobenzene, chlorophenol, chloronitrobenzene, dichlorobenzene, dichlorophenol, diphenylether, phenol, and trichlorophenol. Aliphatic hydrocarbons were also detected, but were not specified. Several metals exceeded IEPA water quality standards in the 1979 sampling. These included copper, lead, manganese, nickel, and zinc.

Additional groundwater investigations are presently in progress at Sites O and R. A contractor for Monsanto is conducting these investigations, and no data have yet been released.

Surface Occurrence

The surface waters in the Sauget sites area which were sampled and analyzed by IEPA personnel include the holding ponds for Cerro Copper (Site I), the pond in the former Hall Construction sand pit (Site M), and the creek waters downstream from Judith Lane (Creek Sectors C through F). The locations of these sample points, as well as the analytical results of the sampling efforts, are included in Appendix A.

Surface Water Quality

Analysis of the Hall Construction (Site M) pond (sampling locations S501 and S502, as presented in the St. John Report; see Appendix A) indicated that the water is somewhat polluted, with copper, phosphorus, and iron concentrations slightly above the water quality

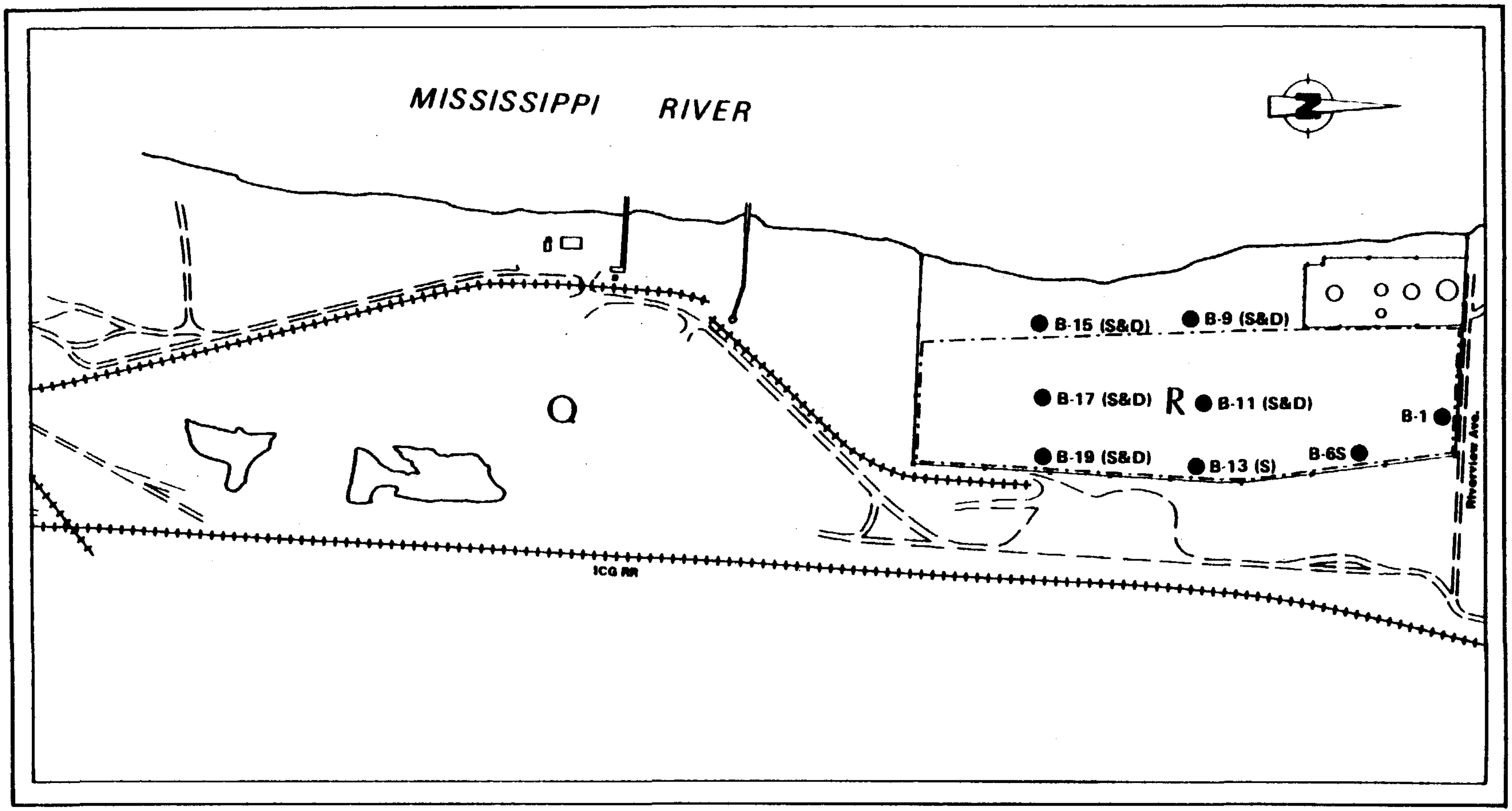

Figure 2–2 LOCATIONS OF MONITORING WELLS AT THE SAUGET TOXIC DUMP SAMPLED BY EPA

Table 2-1

ANALYSIS OF GROUNDWATER SAMPLES FROM
SAUGET TOXIC DUMP
(COLLECTED BY IEPA ON OCTOBER 12, 1979)

	B-9S	B-9D	B-13D	B-15S	B-17S	B-19S
Inorganics						
Arsenic	.01	.004	.002	.002	.002	.007
Cadmium	.02		.01			.01
Chromium	.03		.04		.01	.03
Copper	1.2	.32	.87	.14	.42	1.6
Iron	290	100	130	56	110	230
Lead	0.2		0.3		0.1	0.2
Magnesium	31	10	27	83	11	28
Manganese	7.8	1	1.4	1.8	.99	2.8
Nickel	0.6	0.2	1.9	0.1	0.1	0.2
Zinc	3.3	.36	3	0.4	.52	.87
Organics						
Aliphatic hydrocarbons				*	*	*
Chlorophenol	*	*				.81
Chlorotoluene	70	40	10	.34	11	18
Dichlorobenzene						1.6
Diphenylether					.32	2.1
Phenol	21	56	10	14.3	41.5	22

Notes:

All results in ppm.
Blanks indicate below detection limits

*Contaminants present, but not quantified.

Table 2-2

ORGANIC ANALYSIS OF GROUNDWATER SAMPLES FROM
THE SAUGET TOXIC DUMP
(COLLECTED BY IEPA ON MARCH 25, 1981)

	B-1	B-6S	B-9S	B-9D	B-11S	B-11D	B-15D	B-17D	B-19D
Aliphatic hydrocarbons					4,000				
Biphenylamine	1,800	250			15,000	1,100	1,300	860	660
Chlorobenzene	3,000	130	720	810	1,000	2,800	2,800	650	300
Chlorophenol	6,600	5,300	11,000	12,000	13,000	3,200	3,200		950
Chloronitrobenzene			2,500	1,500					
Dichlorobenzene	2,600				1,000	800	930	420	360
Dichlorophenol	1,100	700				630	2,900	670	
Trichlorophenol								1,200	

Notes:

All results in ug/l (ppb).
Blanks indicate below detection limit.

standards. PCBs were also identified (at 0.9 ppb and 4.4 ppb concentrations).

Analyses of downstream samples S301 (Creek Sector C) and S302 (Creek Sector E) showed slightly elevated concentrations of copper and phosphorus when compared to the standards. A small amount of PCB (1.0 ppb) was detected in S301.

On the other hand, the samples taken from the Cerro Copper (Site I) holding ponds (sampling locations S503 and S504) show elevated concentrations of copper, iron, lead, mercury, nickel, phosphorus, silver, and zinc. PCBs (at concentrations of 22 and 28 ppb) and aliphatic hydrocarbons (23,000 ppb) were also detected in these samples.

Air Quality

Summary data on project area air quality were compiled from the "Illinois Annual Air Quality Report, 1984," published by the IEPA in June 1985. The nearest monitoring location to the project area is at 13th and Tudor in East St. Louis, Illinois. Because the project area is located in a more industrialized area than the monitoring location, some of the recorded values may represent lower pollutant concentrations than occur closer to the project area. The results of the 1984 monitoring are summarized in Table 2-3.

These data indicate that the air quality in the project area exceeds the National and Illinois Ambient Air Quality Standards for particulate matter; however, particulate concentrations have consistently improved since 1979. The standard for ozone was violated twice during the year. The high concentrations occurred in June (1.31 ppm) and July (0.128) ppm). The highest concentration in August equalled the ozone standard (0.120 ppm). All other parameters for which ambient air quality standards exist were within acceptable levels.

No standards exist for sulfates, nitrates, and metals; however, the study area had the highest recorded ambient concentrations of cadmium and selenium in the state. The East St. Louis metropolitan area, which also includes Granite City and Wood River, had the highest metals concentrations in the state.

Table 2-3

STUDY AREA AIR QUALITY SUMMARY

	Study Area Mean	Study Area Std. Dev.	Primary Standard	Secondary Standard
Particulate Matter (TSP) Annual Geometric Mean	77 ug/m^3	1.5	75 ug/m^3	60 ug/m^3
Sulfur Dioxide (SO_2) Annual Arithmetic Mean	0.020 ppm	3.31	0.03 ppm	--
Nitrogen Dioxide Annual Arithmetic Mean	0.023 ppm	1.64 ppm	0.053 ppm	0.053 ppm
Lead Annual Mean	0.44 ug/m^3	--	1.5 ug/m^3	1.5 ug/m^3

	Highest 1st	Highest 2nd	Highest 3rd	Primary Standard	Secondary Standard
Carbon Monoxide					
8-hour average	12.0 ppm	10.8 ppm	10.2 ppm	35 ppm	35 ppm
1-hour average	6.9 ppm	5.7 ppm	5.2 ppm	9 ppm	9 ppm

	Highest 1st	Highest 2nd	Primary Standard	Secondary Standard
Ozone	0.131 ppm	0.128 ppm	0.12 ppm	0.12 ppm

	Study Area Mean	Study Area Std. Dev.	Primary Standard	Secondary Standard
SO_4^{-2} Annual Arithmetic Mean	11.7 ppm	--	--	--
NO^- Annual Arithmetic Mean	3.9 ppm	--	--	--
As Annual Arithmetic Mean	0.008 ppm	--	--	--
Be Annual Arithmetic Mean	0.000 ppm	--	--	--
Cd Annual Arithmetic Mean	0.019 ppm	--	--	--
Fe Annual Arithmetic Mean	1.27 ppm	--	--	--
Mn Annual Arithmetic Mean	0.057 ppm	--	--	--
Ni Annual Arithmetic Mean	0.005 ppm	--	--	--
Se Annual Arithmetic Mean	0.004 ppm	--	--	--

2.3.2 Site-Specific Investigations

Several of the sites in the Dead Creek Project area have been studied in the past, or were part of a general study of possible contaminant sources in the Dead Creek area. These include sites G, H, I, L, M, O, Q, and R. No studies have been conducted to date at sites J, K, or N. The results of the sampling that has been conducted are summarized below.

Site G. Analysis of groundwater samples collected in 1980 and 1981 by the IEPA (as detailed in the St. John Report) revealed chlorinated phenols, benzenes, PCBs, phosphorus, and lead. Surface soil samples revealed arsenic, lead, and PCBs. Subsurface soil sampling in Dead Creek showed PCBs to a depth of 6 feet. Soil samples were also collected by the IEPA on the dates listed above, and are included in the St. John Report.

Site H. Groundwater samples collected downgradient from this site in 1980 and 1981 by the IEPA were found to contain PCBs. No other sampling has occurred at this site.

Site I. Downgradient groundwater samples collected during the IEPA study in 1980 and 1981 revealed contaminants including chlorobenzene, dichlorobenzene, and metals. Surface sediment samples from the holding ponds (Creek Sector A) indicate PCBs, aliphatic hydrocarbons, dichlorobenzene, and arsenic. Surface water sampling at the holding ponds indicated the water contained nickel, arsenic, zinc, PCBs, and aliphatic hydrocarbons.

Site J. No studies have been conducted at this site.

Site K. No studies have been conducted at this site.

Site L. Downgradient groundwater sampling conducted by the IEPA in 1980 and 1981 indicated chlorophenol and cyclohexanone. Soil samples indicated the presence of PCBs and trichlorobenzene. A high level of total hydrocarbons was found in the soil.

Site M. The results of surface sediment sampling conducted by the IEPA in 1981 indicated the presence of PCBs, arsenic, and mercury. Surface water samples, taken at the same time, indicated low levels of PCBs and phosphorus.

Site N. No studies have been conducted at this site.

Site O. Preliminary soil/waste sampling in areas to the northwest of the former lagoons conducted by IEPA in 1982 indicated PCBs and solvents were present at elevated levels. A number of surface soil samples taken in 1983 by the IEPA (and split samples by a private contractor for the Town of Sauget) contained dioxin.

Site P. The IEPA collected soil/waste samples at this site in 1979. However, no results from this sampling effort could be located. IEPA site inspection reports indicate the presence of phosphorus pentasulfide, and miscellaneous containers of residual material.

Site Q. Subsurface soil sampling conducted by the USEPA FIT contractor in 1983 indicated the presence of 63 organic priority pollutants and dioxin. These samples were taken in 1983 in the northern portion of the site. Leachate samples collected in 1982 by the IEPA at the landfill boundary along the Mississippi River revealed several organic solvents.

Site R. In the early 1970s, the groundwater was sampled by the IEPA and analyzed for some indicator parameters. Subsequent groundwater sampling conducted by the IEPA in 1979 and 1981 indicated the presence of numerous organic contaminants in monitoring wells at the site. Leachate sediment samples have been taken on numerous occasions by the IEPA. The leachate and sediment samples taken in 1981 by the USEPA Tactical Assistance Team (TAT) contractor indicated the presence of solvents and dioxin.

3. REMEDIAL INVESTIGATION

The RI involves two parts: preliminary tasks (1 through 6) involving the development of guidelines and background data for the project as a whole, and the primary RI tasks (7 through 11) involving the implementation of the field investigations, analysis of samples, identification of potential environmental risks, remedial technologies, and preparation of the RI report. The scope of work for each of these tasks is described below.

3.1 PRELIMINARY RI TASKS

3.1.1 Task 1: Initial Meeting

An initial meeting was held on September 25, 1985, between IEPA representatives and the E & E staff assigned to the Dead Creek Project. At the meeting, team members were introduced, IEPA objectives, the scope of the study, and sensitive issues were discussed; and channels of communication and reporting were established.

3.1.2 Task 2: Work Plan

This plan defines the objectives of the RI/FS, and details the scope of work and schedule for accomplishing the RI/FS. The Work Plan is a flexible working document which serves to direct the work toward achieving the objectives of the study.

The Work Plan consists of: background information on the project and the project area; a definition of the objectives and scope of work; a Sampling Plan, which addresses all pertinent field activities; a Health and Safety Plan; a Quality Assurance Project Plan (QAPP),

- When tools are to be reused to collect a new sample, they will be decontaminated to avoid cross-contamination.

- Any observable physical characteristics of the soil as it is being sampled (e.g., color, odor, physical state) will be recorded.

- Selected samples will be screened in the field using an OVA. This screening process involves filling a volatile organics bottle half full with sample material and capping the bottle, then heating the bottle in a pan of water, then uncapping the bottle and inserting the OVA probe into the head space and taking a reading.

- When compositing is to be done, it will be done by delineating the areas to be composited and collecting sufficient core samples to characterize the area. Equipment used to collect subsamples for a composite will not need to be decontaminated. However, complete decontamination will be conducted prior to use of tools for another composite. Delineation of the areas will be based on field observations of site scope, soil material, visual observations of contaminants, etc. in the case of the grid sampling, samples will be from within a grid section.

- All pertinent weather information such as air temperature, pressure, wind velocity, sky conditions, and precipitation will be recorded.

3.3 SUBSURFACE SOIL SAMPLING

Subsurface sampling will be conducted using a drill rig with a hollow stem auger. Continuous samples will be collected unless subsurface conditions prevent such sampling. Continuous sampling is done using a 4-inch diameter, 5-foot split-spoon sampler with a catcher at the foot locked into the lead auger flight. Retrieval is accomplished using hex rods through the augers. The sampler is advanced by rotating augers to the desired depth.

If field conditions prevent use of this method, a 2-inch diameter, 18-inch split-spoon will be advanced by conventional methods. This will include attachment of the sampler to an AW rod and a standard 140-pound hammer. Blow counts will be recorded at 6-inch intervals to a total sample depth of 18 inches. Borings will be drilled to depths specified in Section 2.3, unless sample screening dictates stopping at shallower depths.

As samples are retrieved, they will be screened with an OVA and the HNu if deemed necessary. Upon completion of logging, the lithology, the sample will be stored in a clean 8-ounce jar. Compositing will be performed at the hotline.

All drilling and sampling equipment to be reused will be decontaminated as specified in Section 9. When samples are to be composited, mixing will be done using stainless steel containers and tools. These also will be decontaminated between uses. Where possible and appropriate, disposable equipment will be used in order to minimize cross contamination. Prior to the start of the sampling work, all drilling tools and equipment will be washed with high-pressure steam equipment and rinsed with solvent (see Section 9).

As noted above, selected samples will be field-screened using an OVA and the HNu. A preliminary survey will be also conducted by "sniffing" the sample with an OVA and the HNu immediately upon opening the sampling tube.

Upon completion of the drilling, the open hole will be backfilled with drill cuttings or grouted. Any deficit of material will be supplied using clean earthen material. When the water table is encountered while drilling or the boring goes below the fill, grout will be used to seal that portion of the boring. Grout will be mixed and pumped from the mud tub through the hollow stem of the auger as the auger is retrieved. The hole will be filled from the top of the grout line to ground level using drill cuttings. Any excess cuttings will be drummed and disposed of in accordance with applicable regulations.

Subsurface Soil Sample Compositing

Compositing of soil samples will be according to the following procedures:

- Each portion from a depth interval to be composited will be thoroughly mixed in its sample container with a stainless steel tablespoon.

- The material will be chopped, mixed, and stirred until it is homogeneous.

- A stainless steel tablespoon will be used to transfer the material to a composite container. A clean stainless steel tablespoon will be dedicated for materials for each composite.

- The composite container will be sealed and labeled as specified in this plan (Section 7.3).

3.4 GROUNDWATER SAMPLING

Sampling of the existing monitoring wells, residential wells, and newly installed monitoring wells will consist of the following three activities:

- Measurement of depth to water level and total depth of the well (to calculate well volume),

- Evacuation of static water (purging), and

- Collection of the sample.

These activities are described below.

3.4.1 Measurement of Water Level and Well Volume

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.

- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.

- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

where:

V = Static volume of well in gallons;

T = Depth of water in the well, measured in feet;

r = Inside radius of well casing in inches; and

0.163 = A constant conversion factor which compensates for πr^2 h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and π (pi).

3.4.2 Purging Static Water

Before a groundwater sample is obtained, the static water must be purged to ensure that a representative groundwater sample is taken. A minimum of three static water volumes will be purged from the well prior to collecting the samples. Purging and sampling will be performed using a stainless steel bailer. Since the water removed from the well during the purging process could contain hazardous materials, it will be containerized, not discharged on the ground.

3.4.3 Sample Collection

Sampling personnel will take precautions against cross contamination when using one sampling apparatus for a series of samples. If possible, "clean" or "background" samples will be taken first. Before and after each sample is taken, the apparatus will be decontaminated as specified. Sample collection procedures are as follows:

- A stainless steel bailer (decontaminated according to the procedures presented in Section 9) will be used to collect the groundwater samples.

- Dedicated bailers will be used for monitoring wells. Residential well samples will be collected from existing plumbing as close as possible to the pump and prior to any water softening apparatus.

- When transferring water from the bailer to sample containers, care will be taken to avoid agitating the sample, which promotes the loss of volatile constituents.

- Samples to be analyzed for metals will be filtered in the field using a .45-micron filter and preserved with nitric acid prior to shipment for analysis. Filtering equipment used will be decontaminated between samples to avoid cross contamination. Field filtration requires particular skill if contamination is to be avoided.

- Any observable physical characteristics of the groundwater (e.g., color, sheen, odor, turbidity,) as it is being sampled will be recorded.

- Weather conditions at the time of sampling will be recorded (e.g., air temperature, sky condition, recent heavy rainfall, drought conditions).

3.5 SURFACE WATER/SEDIMENT SAMPLING

3.5.1 Surface Water Sampling

Surface water samples will be collected according to the following procedures:

- A wide-mouth glass bottle to be used for sampling will be dipped into the creek and rinsed three times and the bottle will then be dipped to collect the sample.

- The sample will be collected in such a manner as to prevent agitation of the water, which promotes the loss of volatile organics and increases the dissolved oxygen content.

- The samples will be transferred into 1/2-gallon glass bottles and 40-ml VOA bottles. The wide-mouth bottle will be refilled as many times as necessary to fill all required bottles.

- The temperature, pH, and specific conductivity of the water will be measured, and current speed/volume will be recorded at the time the sample is taken.

- Any observable physical characteristics of the water (e.g., color, odor, turbidity) as it is being sampled will be recorded.

- Weather conditions at the time of sampling will be recorded, (e.g., air temperature, sky conditions, recent heavy rainfalls, and drought conditions).

3.5.2 Sediment Sampling

Sediment samples will be collected from Dead Creek using a Peterson dredge or stainless steel corers. The sampling procedure will be as follows:

- The Peterson dredge will be decontaminated as specified in Section 9.

- The dredge will be lowered into the creek sediment until sufficient resistance is encountered to release the retainer catch. The dredge will then be withdrawn from the sediments.

- The contents of the dredge will be placed in a clean stainless steel pan and composited. A composite sample of the sediment will be transferred to an 8-ounce jar.

3.6 SOIL GAS SURVEY

Soil gas analyses will be performed along a grid covering a presurveyed area. Results will be compiled and plotted on a site base map. Areas with high readings may be resurveyed at smaller intervals.

One sample will be taken outside the area of contamination to establish background levels.

Experience with soil gas monitoring has shown that the weather conditions most conducive to a successful survey are warm, dry, low-wind conditions following several days of warm to hot weather. The survey will be planned for such conditions.

The survey will consist of three soil gas samples taken at 4, 7, and 10 feet below the surface at each sampling location. Although sample locations have generally been identified, the exact locations will be determined in the field based upon an assessment of field conditions, surface evidence of past dumping practices and contamination, and topographic relief.

The soil gas survey will be conducted using either a slam bar/OVA technique or a perforated drive point/bag method. The slam bar technique uses a steel rod that is driven into the soil with a weight that slides along the top of the rod. The slam bar will be driven into the soil to a depth of three feet or to maximum penetration. When the slam bar is withdrawn, the air in the resultant hole will be analyzed with an OVA for volatile organic compounds.

The primary equipment to be used for the perforated drive point/bag method consists of the following:

1. A miniature well point sampler, 5/8-inch in diameter, stainless steel, with 3/8-inch hollow center. The shaft is tipped with a sharp penetrating point and has a narrow, vertically slotted screen. The internal-thread 2.5-foot sections are driven into the soil using a special cylindrical hammer. Connectors allow hook-up to various types of sample analysis equipment.

2. An OVA for determining the total concentration of organic vapors using a flame ionization detector.

The following procedures will be followed at each of the sampling locations.

1. A decontaminated well point sampler will initially be driven into the soil to a depth of 4 feet at each location.

2. Sample tube fittings will be attached to the samples and one volume of air purged from the system using a syringe or piston displacement device.

3. A sample collection bag will be attached to the system and the bag will be filled using a syringe or piston displacement device. The sample bag will then be carried to a van for analysis.

4. The OVA will be set up and operated in the van to standardize analytical conditions. Bag samples will be allowed to equilibrate with internal van conditions. Once equilibrium has been reached, the bag sample will be connected to the OVA (operated in survey mode) and analyzed for total volatile organic substances. An activated carbon filter will be used to check for the presence of methane. Prior to each set of analyses, the OVA will be "zeroed" in a background area and ambient background readings will be recorded. Temperature readings will be recorded during the background measurement and during the sampling.

5. Depending on field conditions, it may be necessary to substitute a slightly different sample collection and analysis procedure. Should weather and soil conditions preclude the use of the analysis equipment described, the equipment and/or techniques will be modified accordingly. All modifications will be documented and appropriate controls instituted for maintaining sample integrity. In any case, the equivalent of one air volume for each sample and depth will be purged prior to collecting the sample for analysis. If no contaminants are detected in a sample, the sample bags may be reused.

6. Upon completion of sampling at 4 feet, the well point will be blown clear with compressed air (D or E quality) and the well

point will be driven to the next sampling interval (samples will be collected at 4, 7, and 10 feet). Procedures 1 to 5 will be repeated at each interval.

7. Upon completion of sampling at each location, the well point will be withdrawn from the ground and the hole backfilled by injecting a bentonite slurry into it.

8. The well point will be decontaminated as specified in Section 9. The sample analytical equipment tubing will be purged until a stable "zero" or background reading is obtained.

9. All data well point locations and sample results will be recorded in a log book of field activities. Data will be tabulated and plotted on a site base map and used for assessment and planning of future investigative work.

10. A duplicate analysis will be collected after every 20 analyses.

The OVA will be calibrated in accordance with the manufacturer's specifications twice daily, once prior to commencing operations and once after 4 hours of field sampling.

3.7 SAMPLING EQUIPMENT

Sampling equipment will be the responsibility of the equipment manager, who will assure that the items required for sampling and the necessary quantities are on-site prior to sampling. All equipment will be checked for serviceability and calibrated, if necessary, prior to shipment. Similar checks will be made at the sampling location. Any sampling device that is reusable will be decontaminated before reuse. The equipment required for sampling will include, but will not be limited to, the items listed in Table 3-1.

Table 3-1

MAJOR SAMPLING EQUIPMENT LIST

Item
Drilling rig, rod, and other components
4-inch diameter, 5-foot split spoons or 2-inch diameter, 18-inch split spoons
Hollow stem augers
Cathead and 140-pound hammer
Van
Boat
Peterson steel dredge
HNu photoionizer, calibration kit
Organic vapor analyzer (OVA), calibration kit
Combustible gas/O_2 meter, calibration kit
Temperature, pH, conductivity meter
Dust particulate counters
High volume particulate samplers
Tenax tube collectors
Meteorological data collection station
Magnetometer
Portable photovac GCs
<u>Sample Containers</u>
8-ounce glass sample bottles with Teflon lids
1/2-gallon glass sample bottles
1-liter polyethylene sample bottles with reagents
800-mL polyethylene sample bottles for inorganic sample collection
40-mL glass VOA bottles
Shipping coolers and DOT labels
Chain-of-custody forms and seals
Filter paper and prefilters
Teflon and/or stainless steel well bailers
Water level indicator with calibrated weighted line
12-foot engineer's steel tape
Stainless steel pans
Stainless steel spoons
Stainless steel scoop/trough
Miniature well point sampler, 5/8-inch diameter stainless steel with 3/8-inch hollow centers
Tubes and collection bags
Compressed air (D or E quality) tanks
Miscellaneous disposables (rope, bags, paper towels, etc.)
<u>Documents</u>
Labels
Field notebooks
Sampling plan
Site maps

Note: Sampling surfaces that come in contact with samples for analysis will be either stainless steel, teflon, high density polyethylene (HDPE), or glass.

4. SAMPLE PREPARATION

4.1 COORDINATION WITH ANALYTICAL LABORATORY

It is important that any limitation on sampling due to laboratory capacity or special sample requirements be determined prior to sampling. Based on the analyses required, no special sampling requirements are anticipated. However, the site team leader will be responsible for contacting E & E's Analytical Services Center (ASC) well in advance of sampling to determine that laboratory capacity is adequate. At present, all analytical work is to be performed by the ASC with the exception of dioxin analyses. The dioxin analyses will be performed by a USEPA contract laboratory approved for dioxin analysis.

4.2 SAMPLE CONTAINERS

The sample containers, volumes, preservatives, and holding times will be as indicated in Tables 4-1 and 4-2. Prewashed sample containers will be provided by the ASC and prepared in accordance with USEPA procedures. Filled containers to be shipped or stored on-site will be wiped with paper towels. All samples will be iced prior to shipment.

4.3 ANALYTICAL METHODS

All analytical methods to be utilized for this project are USEPA-approved. Methodologies specify QC requirements, including calibration, tuning, and laboratory QC samples.

In addition, all analytical staff members will follow protocols set forth in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and QA/QC Procedures Manual (August 1985).

Table 4-1

SAMPLE CONTAINERS, VOLUMES, PRESERVATION, AND HOLDING TIMES FOR WATER SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	7 days
Extractable Organics, PCBs, Pesticides	1/2-gallon bottles with Teflon-lined caps	Two (2); total volume approx. 1 gallon; fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days
Metals	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill 7/8 full	Nitric acid to below pH 2 (approx. 1.5 ml con HNO_3 per liter)	6 months
Cyanides	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill completely	Sodium hydroxide to pH 12 and cool to 4°C (ice in cooler)	24 hours, if sulfide present; 14 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

Table 4-2

SAMPLE CONTAINERS, VOLUMES, PRESERVATION,
AND HOLDING TIMES FOR SOIL SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	10 days
Extractable Organics, PCBs, Pesticides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 10 days; analyzed within 30 days
Metals	8-oz. glass jar with Teflon-lined cap	One (1); fill half-full	Cool to 4°C (ice in cooler)	6 months
Cyanides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	24 hours, if sulfide present;
2,3,7,8 TCDD	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, April 1986.

5. FIELD PERSONNEL REQUIREMENTS

The sampling team for the project will consist of three to five members, all of whom are experienced in the types of sampling activities planned at the Dead Creek sites. The team members' duties are listed below. Record custodian and site safety duties will be rotated, so team members other than the team leader may have either function during the sampling.

Team Leader--will have the overall responsibility for the sampling team's activities. Responsibilities include overall team coordination; relaying information to the record custodian; directing team members to the sample locations; directing sample gathering methods and sample quantities; and any other operations relevant to the sampling effort.

Record Custodian--will record all information in the appropriate field logs. He will also prepare sample labels and bottles, and provide other necessary support for sampling.

Site Safety Monitor--will be responsible for the team's overall safety. He will make the necessary measurements of explosivity, O_2, etc., and will also insure that proper safety protocols are followed. In addition, the site safety monitor will assist in collecting samples.

Additional team members (samplers) will be present to lend support where necessary, for example in sample gathering, sample preparation for shipping, etc., and in general assist in all phases of sampling when required by the team leader.

6. SITE LOGISTICS

At each site, the layout will consist of an exclusion zone which is entered through a support zone and a contamination reduction zone. The line between the exclusion zone and the contamination reduction zone is called the hot line. All areas where contamination has been found are in the exclusion zone; a support zone will be designated upon arrival at the site.

No one will enter the exclusion zone without the required level of protective equipment and air monitoring equipment. Levels of protection will vary from site-to-site and in accordance with the type of sampling activities being performed. On the basis of air monitoring data, the level of protection for each site may also be upgraded and downgraded as directed by the site safety monitor. (See the Site Safety Plan for levels of protection.) Team members will enter the exclusion zone in pairs, employing the "buddy system," and a pair will exit the exclusion zone at the same time. Upon exiting the exclusion zone, personnel and equipment will be decontaminated. Work will be limited to daylight hours.

Some specific considerations for each task are noted below:

Surface Soil Sampling

- Monitoring of the surface soil sampling locations for combustibility and oxygen content will be performed prior to and during sampling. Organic vapor readings may be used as the basis for upgrading and downgrading the level of personnel protection.

* Sampling spoons and any other equipment that will be reused will be decontaminated before and after use.

Subsurface Soil Samples

* Monitoring of the split-spoon sampling locations for combustibility and oxygen content will be performed prior to and during sampling.

* Split-spoon samplers, augers, and other equipment that will be reused will be decontaminated before reuse.

* The decontamination of the split-spoons will be completed at the sampling location.

Monitoring Well Sampling

* Monitoring of wells for combustibility, oxygen content, and organic vapor content will be performed upon opening each well. Where elevated combustible gas readings or organic vapor readings are found, the well will be allowed to vent prior to determining the static water level and purging. Air monitoring will continue during purging and sampling of the well.

* All purge water will be placed in a drum for later disposal.

* Any sampling devices used will be decontaminated.

Creek Water/Sediment Sampling

* When conditions warrant, personnel collecting the sample will be secured to the bank of the creek with a safety line.

Soil Gas Survey

* Monitoring of the soil gas survey locations for combustibility and oxygen content will be performed prior to and during the

survey. Organic vapor readings observed during the survey may be used as the basis for upgrading or downgrading the level of personnel protection.

- All equipment that will be reused will be decontaminated before and after reuse.

7. SAMPLE HANDLING, PACKAGING, AND SHIPPING

The transportation and handling of samples will be accomplished in such a way as to protect the integrity of the sample and also preclude detrimental effects due to the possible hazardous nature of the samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177.

Chain-of-custody requirements will comply with USEPA sample handling protocols. Sample control and chain-of-custody procedures are presented in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual (August 1985).

7.1 SAMPLE PACKAGING

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed.

- All sample lids will remain with the original containers. Custody seals will be affixed.

- The sample volume level will be marked by placing the top of the label at the sample level, or by using a grease pencil. This procedure will help the laboratory determine if any leakage occurred during shipment. The label should not cover any bottle preparation QA/QC marks.

- Sample bottles will be secured with a custody seal and placed in a plastic bag to minimize the potential for vermiculite contamination.

- Shipping coolers must be filled initially with approximately 3 inches of vermiculite or zonolite.

- The secured sample bottles must be placed in the cooler in such a way as to ensure that they do not touch one another.

- Environmental samples will to be cooled. The use of "blue ice" or some other artificial icing material is preferred. If necessary, ice may be used, provided that it is placed in plastic bags. Ice is not to be used as a substitute for packing materials.

- Any remaining space in the cooler will be filled with inert packing material. Under no circumstances will material such as sawdust, sand, etc., be used.

- A duplicate custody record will be placed in a plastic bag and taped to the bottom of the cooler lid.

Note: The ASC does not knowingly accept samples with high levels of radioactivity or dioxins, or any samples for which ASC handling procedures may be insufficient to protect laboratory employees. Field staff will take all feasible precautions to ensure that neither they nor ASC personnel are exposed to unduly hazardous materials. Note that field staff are in many cases equipped with personal protection and breathing apparatus not used by ASC personnel.

7.2 SHIPPING CONTAINERS

Environmental samples will be properly packaged and labeled for shipment and dispatched to the ASC laboratory for analysis. A separate chain-of-custody record will be prepared for each container. The following requirements for shipping containers will be followed.

Shipping containers will be padlocked or custody-sealed for shipment, as appropriate. The container custody seal will consist of filament tape wrapped around the package at least twice and custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking a seal.

All shipping containers must be secured by field personnel with a proper custody seal, marked with indelible pen or ink, and addressed to Ecology and Environment, Inc., Analytical Services Center, 4285 Genesee Street, Buffalo, NY 14225.

Field personnel will arrange for transportation of samples to the ASC. When custody is relinquished to a shipper, field personnel will telephone the ASC custodian (716/631-0360) to inform him of the expected time of arrival of the shipment and advise him of any time constraints on sample analysis. For samples intended for Saturday delivery, the ASC must be notified as early in the week as possible, and in no case later than Thursday at 3 p.m. (eastern standard time). Samples will be retained by the ASC for 30 days after the final report is submitted.

7.3 MARKING AND LABELING

The following procedures will be used for marking and labeling sample packages.

- Use abbreviations only where specified.

- The words "This End Up" or "This Side Up" will be clearly printed on the top of the outer package. Upward-pointing arrows will also be placed on the sides of the package. The words "Laboratory Samples" will also be printed on the top of the package.

- After a package has been sealed, two chain-of-custody seals will be placed on the container, one on the front and one on the back. The seals will be protected from accidental damage by placing clear tape over them.

8. DOCUMENTATION

8.1 SAMPLE IDENTIFICATION

All containers of samples collected for the Dead Creek Project will be identified using the following format on a label or tag fixed to the sample container (labels are to be covered with Mylar tape):

DC-XX-O/D

- DC - This set of initials indicates the sample is from the Dead Creek Project.
- XX - These characters identify the sample location. If the identification is only one character, the first of these characters will be "0." Actual sample locations will be recorded in the task log.
- O/D - This character will be either "O" for original sample, or "D" for duplicate.

Each sample will be labeled and sealed immediately after collection. To minimize handling of sample containers, labels will be filled out prior to sample collection. The sample label will be filled out using waterproof ink and firmly affixed to the sample container and protected with Mylar tape. Labels must include:

- Name of collector (team leader),
- Date and time of collection,
- Sample number,
- Sample volume,
- Analysis required,
- pH, and ____________ Temperature?
- Preservatives used.

8.2 DAILY LOGS

Daily logs and data forms are necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if they are required to give testimony during legal proceedings.

Daily logs will be kept in a bound waterproof notebook containing numbered pages. Entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason. Corrections will be made according to the procedures given at the end of this section. The daily logs will include a site log and a task log.

The Site Log will include a complete summary of each day's activities at the site. The site log is the responsibility of the team leader.

The Task Log will include:

- Name of person making entry (signature).
- Time of day entry is made.
- Levels of personnel protection:
  - Level of protection originally specified,
  - Changes in levels of protection,
  - Reasons for changes, and
  - Time of changes.
- Names of team members on-site.
- Time spent on-site.
- Tasks performed.
- Changes in instructions or activities that occurred on-site.
- Weather conditions, wind direction, etc.

- Documentation on photographs taken.
- Documentation on samples taken, including:
  - Sampling location,
  - Station numbers,
  - Sampling date and time,
  - Name of sampling personnel,
  - Type of sample (composite, grab, etc.), and
  - Sample medium (e.g., groundwater).
- On-site measurement data.
- Field observations and remarks.
- Unusual circumstances or difficulties.
- Initials of person recording the information.

8.3 LOGBOOK CORRECTIONS

No pages will be removed from logbooks for any reason. If corrections are necessary, these must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Most corrected errors will require a footnote explaining the correction.

8.4 PHOTOGRAPHS

Photographs will be taken only as directed by the team leader. Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information will be noted in the task log concerning photographs:

- Date, time, location of photograph,
- Photographer (signature),
- Description of subject of photograph,
- Weather conditions,
- Reasons why photograph was taken,
- Sequential number of the photograph and the film roll number, and
- Camera lens system used.

After the photographs have been developed, applicable information in the field notebook should be transferred to the back of each photograph.

8.5 CHAIN-OF-CUSTODY

The primary objective of the chain-of-custody procedures is to provide an accurate written record that can be used to trace the possession and handling of a sample from the time of collection through analyses. A sample is in custody if it is:

- In someone's physical possession;
- In someone's view;
- Locked up; or
- Kept in a secured area restricted to authorized personnel.

8.5.1 Field Custody Procedures

- As few persons as possible should handle samples.

- The sample collector is personally responsible for the care and custody of samples until they are transferred to another person or properly dispatched.

- The sample collector will record sample data in the field notebook.

- The team leader will determine whether proper custody procedures were followed during the fieldwork and decide if additional samples are required.

8.5.2 Sample Tags

Sample tags will be attached to or affixed around each sample container in the field. The sample tags will be placed on bottles so as not to obscure any QA/QC data on the bottles. Information on tags will be printed in a legible manner using waterproof ink. Information on sample tags will be sufficient to enable cross-reference with the site logbook. QC samples are subject to the same custodial procedures and documentation as primary samples.

8.5.3 Chain-of-Custody Record

The chain-of-custody record must be fully completed in duplicate, using black carbon paper where possible, by the field technician who has been designated by the project manager as responsible for sample shipment. In addition, if samples will require rapid turnaround in the laboratory because of project time constraints or analytical concerns, the person completing the chain-of-custody record should note these constraints in the remarks section of the custody record.

8.5.4 Transfer of Custody and Shipment

- Samples will be accompanied by a chain-of-custody record. When transferring samples, individuals relinquishing and receiving them must sign, date, and note the time on the record. This record documents sample custody transfer.

- Samples will be dispatched to the ASC for analysis with a separate chain-of-custody record accompanying each shipment. Shipping containers must be sealed with custody seals. The method of shipment, name of courier, and other pertinent information are entered in the "Remarks" section of the chain-of-custody record.

- All shipments must be accompanied by the chain-of-custody record identifying their contents. The original record will accompany the shipment, and the yellow copy will be retained by the team leader.

8.5.5 Custody Seals

Custody seals are preprinted adhesive-backed seals with security slots designed to break if the seals are disturbed. A custody seal is placed over the cap of individual sample containers by the sampling technician. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) are sealed in as many places as necessary to ensure security. Seals must be signed and dated before use. Upon receipt at the laboratory, the custodian will check (and certify, by completing logbook entries) that seals on boxes and bottles are intact. Clear tape will be placed over the seals to ensure that seals are not accidentally broken during shipment.

9. DECONTAMINATION

Sampling methods and equipment have been chosen to minimize decontamination requirements and the possibility of cross contamination. Any sample tubing, rope, rods, etc., will be disposed of after sampling. Sampling equipment used on more than one location will be decontaminated between locations by following these steps:

- Steam clean (drilling equipment only);
- Scrub with brushes in trisodium phosphate (TSP) or equivalent solution;
- Rinse with deionized water;
- Rinse with acetone;
- Rinse with hexane;
- Rinse with acetone; and
- Rinse with deionized water.

10. SITE MAPS

This section contains location specific maps for the Dead Creek Project sites. The maps include the location of all existing wells at the sites as well as all proposed monitoring well locations and delineation of specific sampling points where possible.

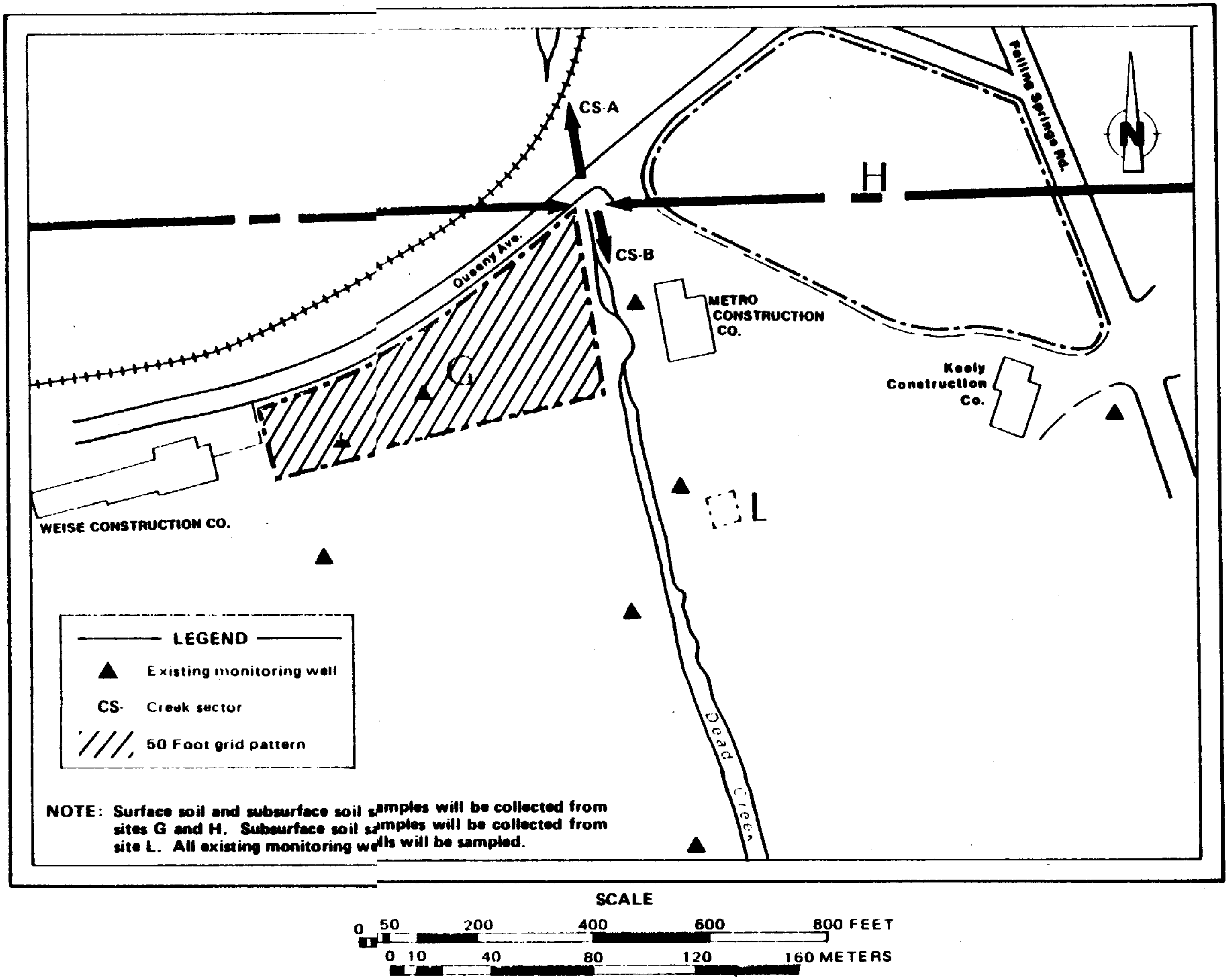

Figure 10–1 DEAD CREEK SITE AREAS G, H AND L, AND CREEK SECTORS A AND B SAMPLING

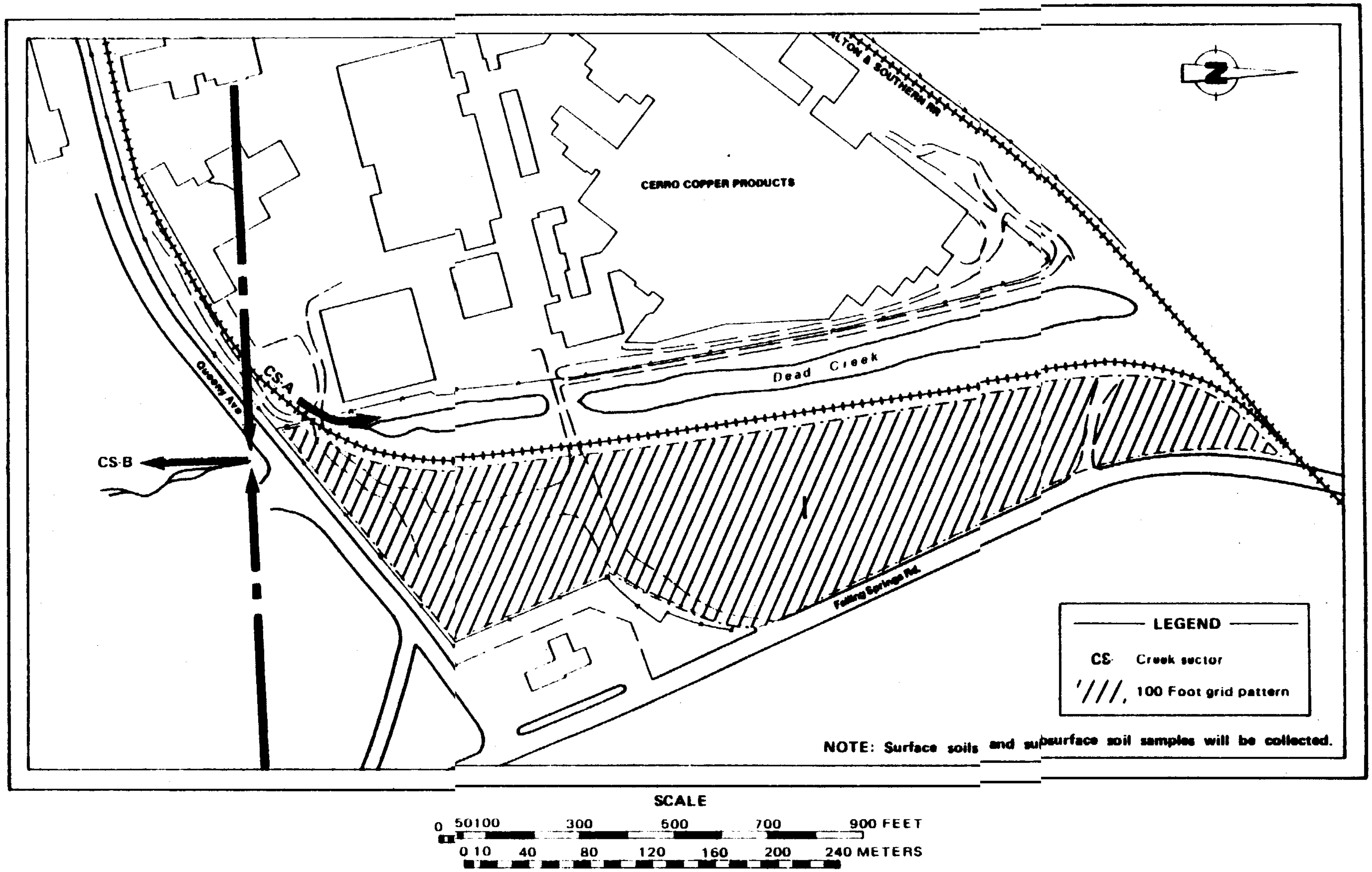

Figure 10–2 DEAD CREEK SITE AREA I, AND CREEK SECTORS A AND B SAMPLING

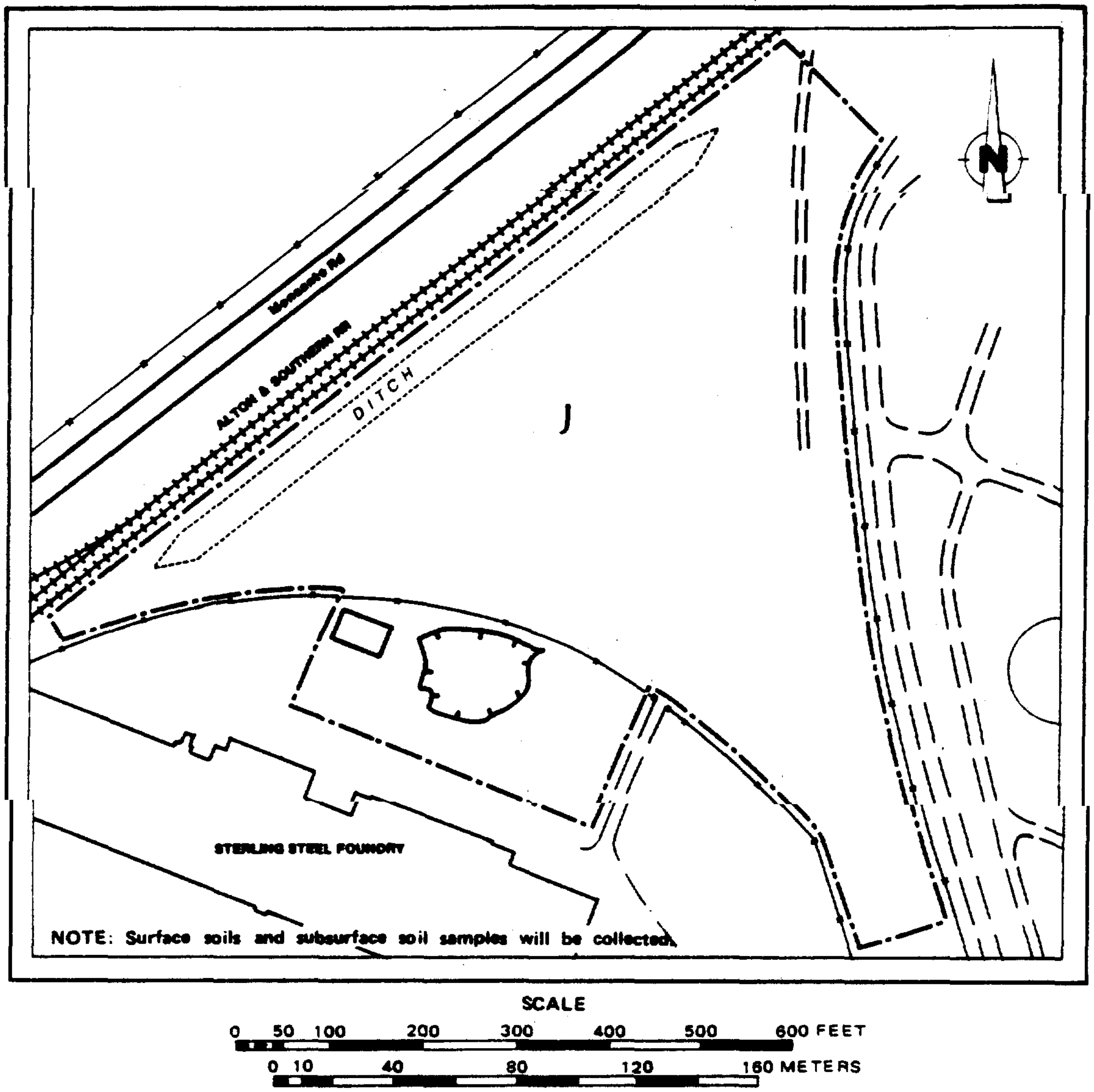

Figure 10—3 DEAD CREEK SITE AREA J SAMPLING

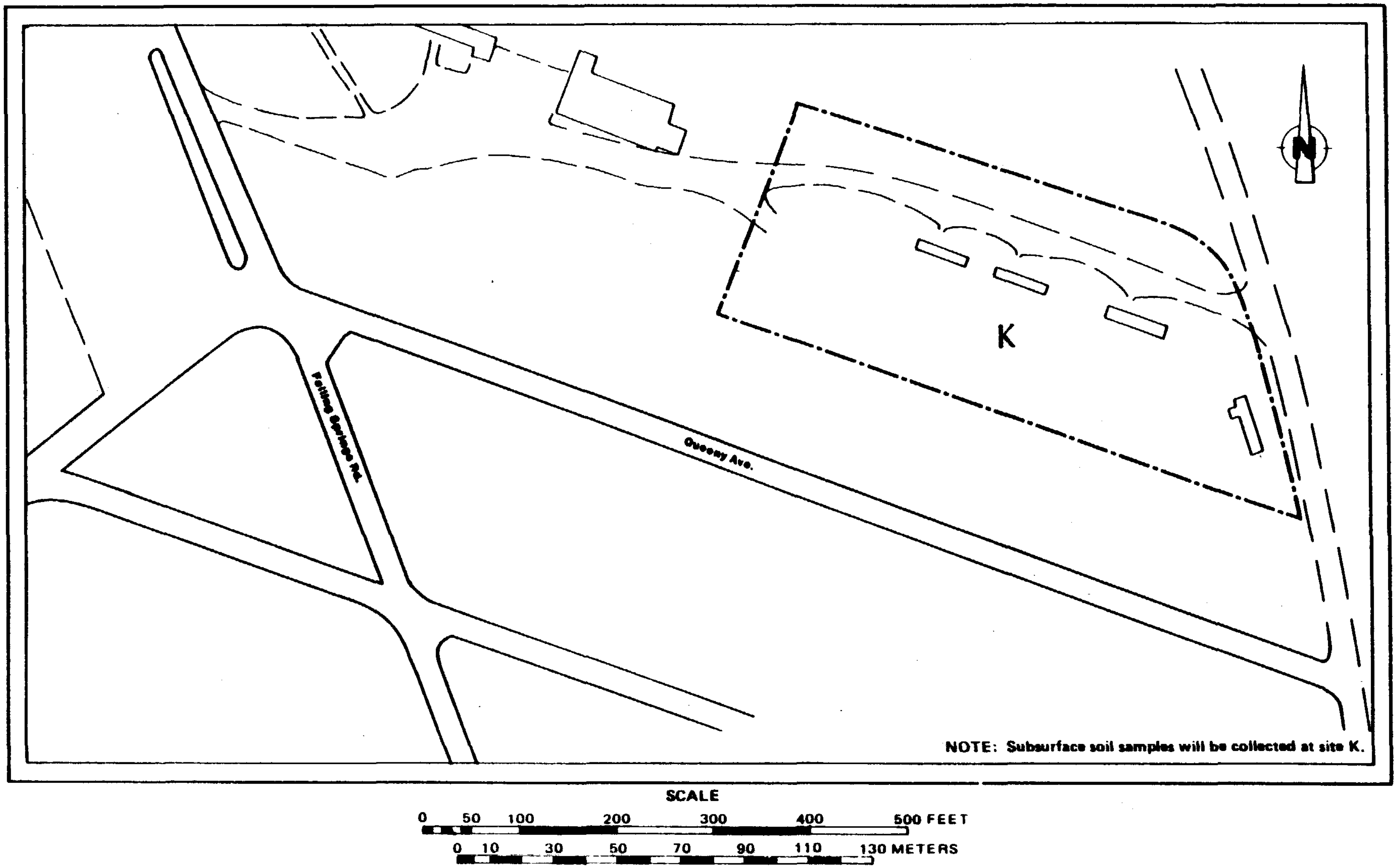

Figure 10–4 DEAD CREEK SITE AREA K SAMPLING

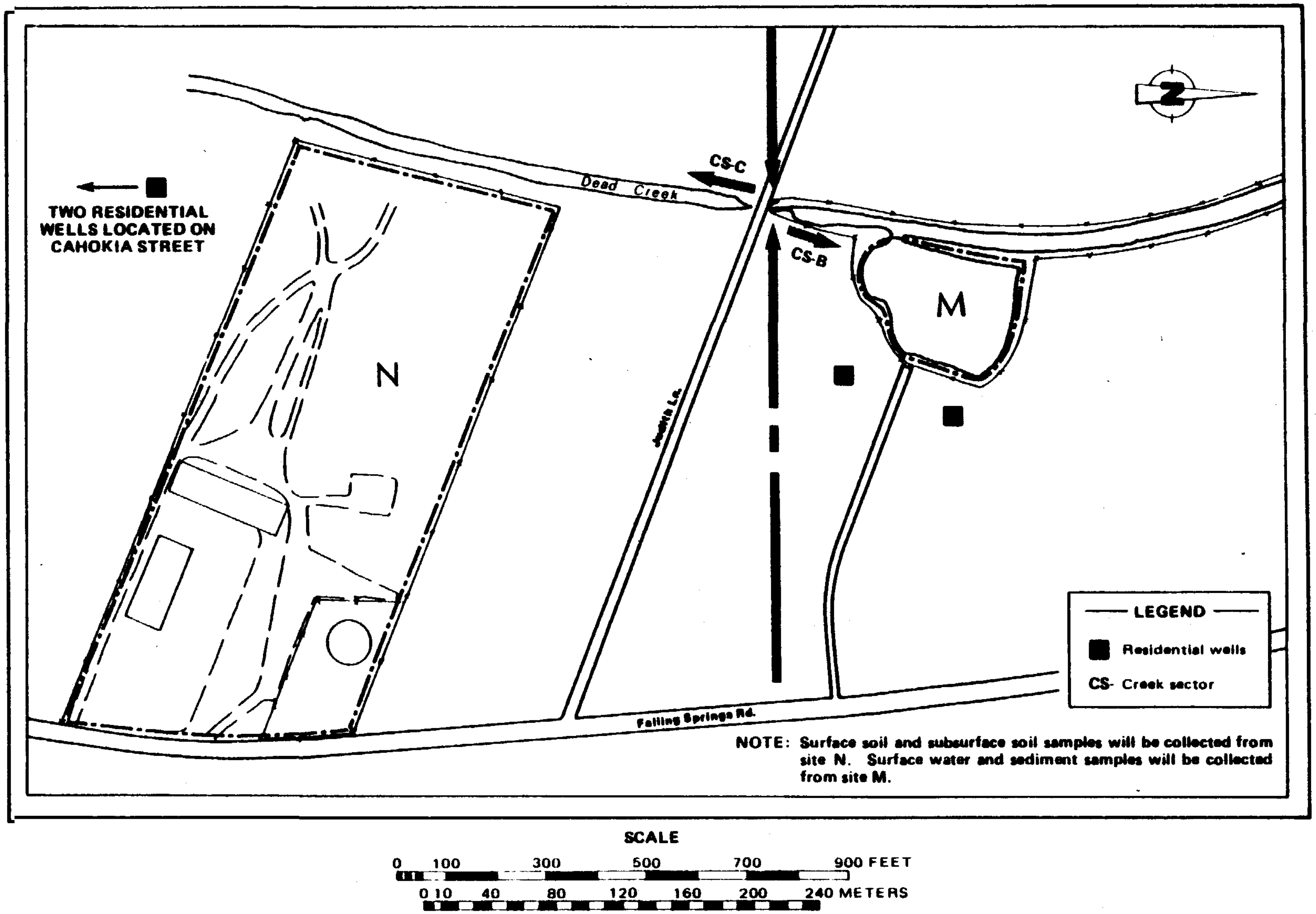

Figure 10–5 DEAD CREEK SITE AREAS N AND M, AND CREEK SECTORS B AND C SAMPLING

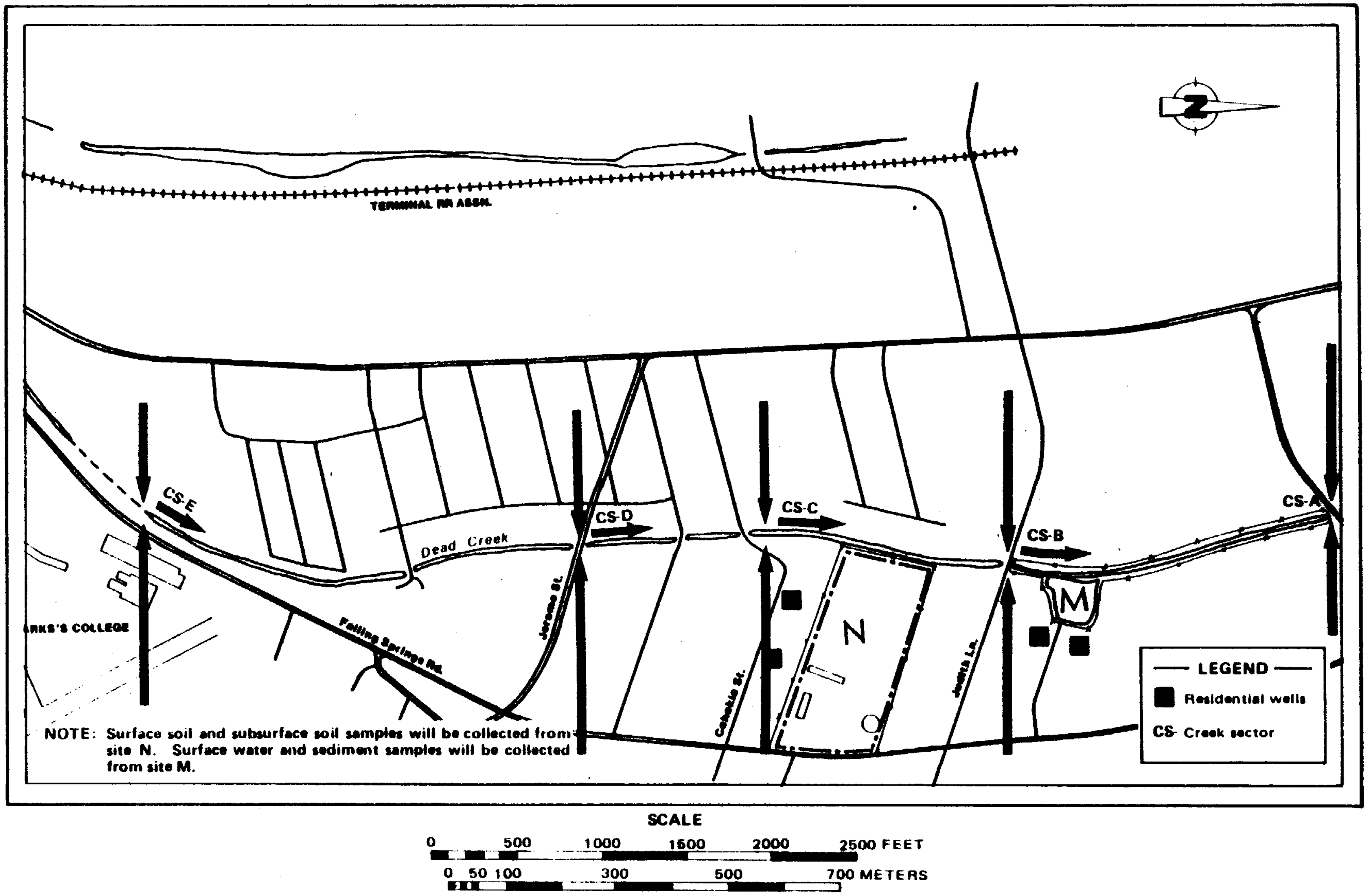

Figure 10–6 DEAD CREEK SITE AREAS N AND M, AND CREEK SECTORS A, B, C, D, E, AND F SAMPLING

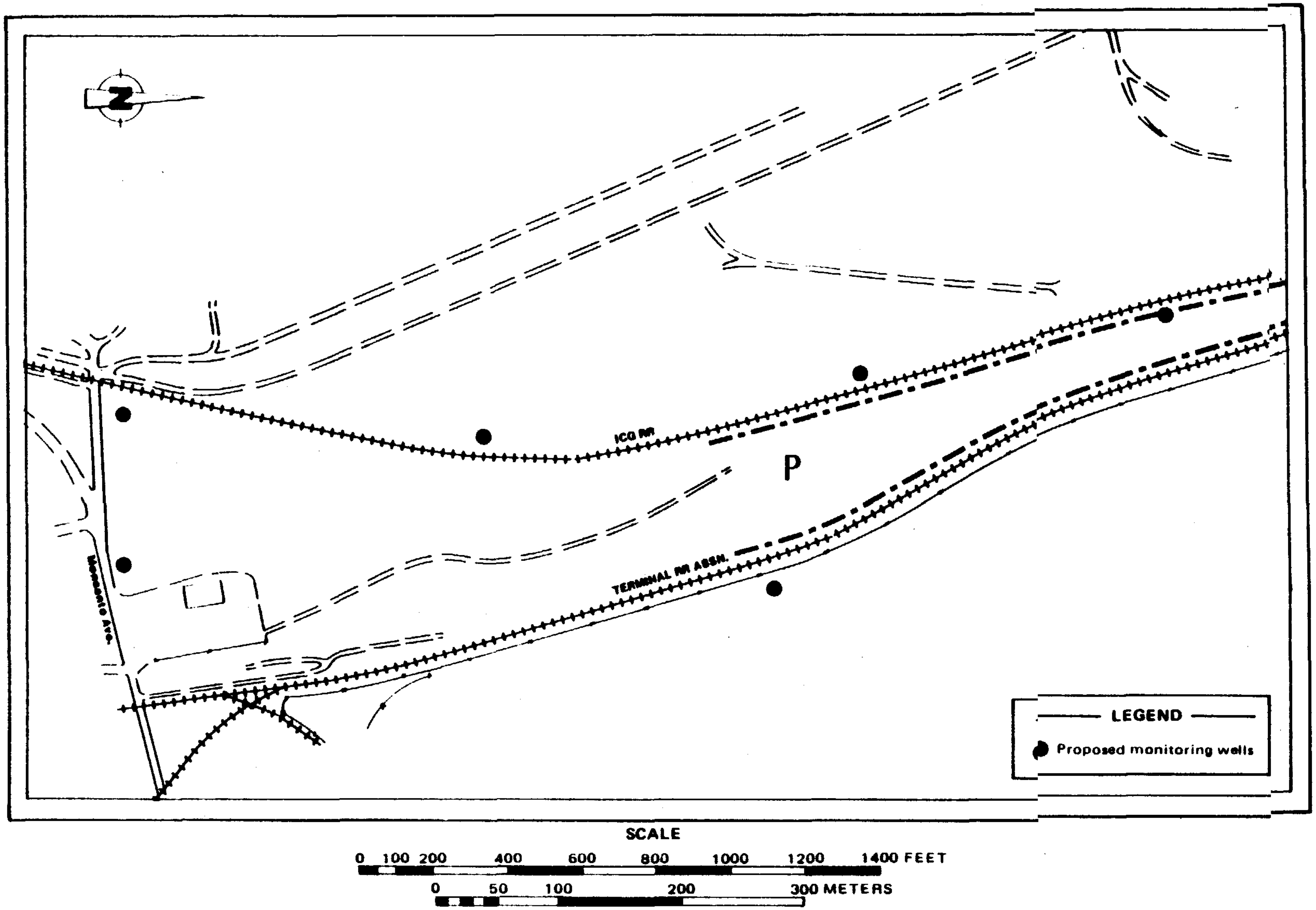

Figure 10–7 DEAD CREEK SITE AREA P PROPOSED MONITORING WELL LOCATIONS

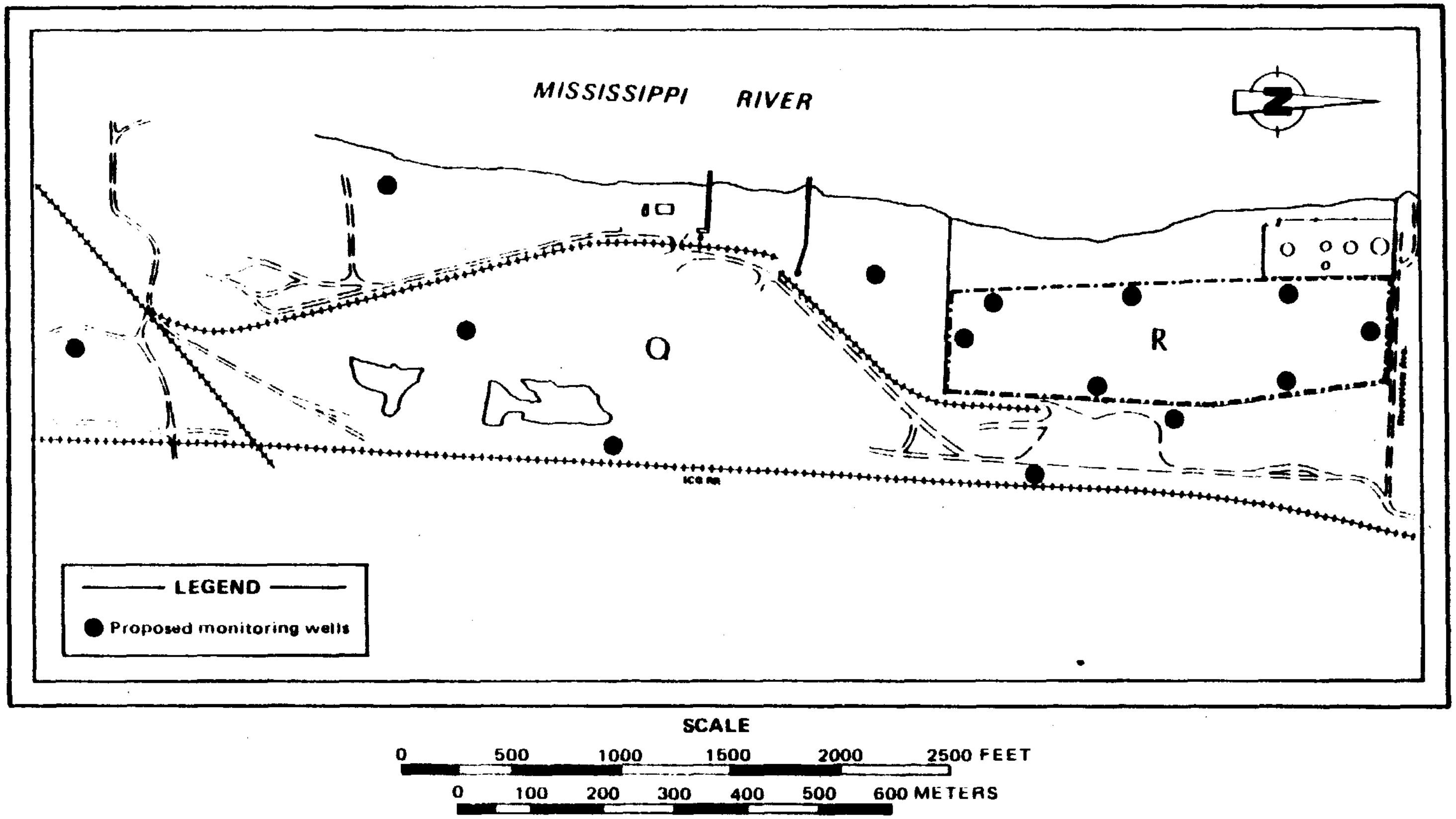

Figure 10–8 DEAD CREEK SITE AREAS Q AND R PROPOSED MONITORING WELL LOCATIONS

APPENDIX C

HEALTH AND SAFETY PLAN
DEAD CREEK PROJECT

September 1986

Prepared for:

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491

International Specialists in the Environment

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ecology and environment, inc.

HAZARDOUS AND TOXIC MATERIALS TEAM
SITE SAFETY PLAN

A. GENERAL INFORMATION

SITE: Dead Creek Project Job No.: IL-3020

LOCATION: Sauget and Cahokia, Illinois

PLAN PREPARED BY: Dan Sewall DATE: 9/22/86

APPROVED BY: [signature] DATE: 10-1?-86

OBJECTIVE(S): Monitoring Well Installation, Surface and Subsurface Soil Sampling, Surface and Groundwater Sampling, Soil-Gas Survey.

PROPOSED DATE OF INVESTIGATION: October 1986 - March 1987

BACKGROUND REVIEW: Complete: ___ Preliminary: X

DOCUMENTATION/SUMMARY: Overall Hazard: Serious: X Moderate: ___

Low: ___ Unknown: ___

B. SITE/WASTE CHARACTERISTICS

WASTE TYPE(S): Liquid X Solid X Sludge X Gas ___

Corrosive X Ignitable X Radioactive ___ Volatile X

Toxic X Reactive X Unknown X Other (Name) teratogenic; carcinogenic, mutagenic, persistent

FACILITY DESCRIPTION: The study area consists of 18 sites (370 acres) including: manufacturing facilities, inactive landfills, surface impoundments, and Dead Creek.

Principal Disposal Method (type and location): Landfill (area filling), waste piles, surface impoundments, open dumping.

Unusual Features (dike integrity, power lines, terrain, etc.): Power lines traverse the entire area west of Rte 50. A flood control levee is located immediately east of Site Q - see map.

Status: (active, inactive, unknown) Inactive, other than manufacturing facilities.

History: (injuries; complaints; previous agency action): Illinois EPA has received several complaints dating back to the early 1970's concerning dumping in Dead Creek. A fence was constructed around the creek and Site M from Judith Ln. to Queeny Ave. as a result of a preliminary study done by IEPA in this area. The Illinois Pollution Control Board and the Attorney General's Office have been involved in actions concerning Sites Q and R.

C. HAZARD EVALUATION
(Use Supplemental Sheets if Necessary)

Summary (attach copy of available chemical information from Sax, Merck Index, Chmtads, etc.): The following is a brief list of contaminants found at various sites in the study area during past agency and contractor investigations. This list is by no means a complete compilation of all contaminants found or suspected, and is provided simply as an indication of the types of contaminants which may be encountered during field activities.

2,3,7,8-TCDD (Dioxin)
PCB's (Not specified)
o-Dichlorobenzene
Dichlorophenol
Lead
Cadmium
Arsenic
Chlorotoluene
Phosphorus (not specified)
Pentachlorophenol
Vinyl chloride
Phosgene
Mercury
See attached hazard evaluation sheets for specific information.

D. SITE SAFETY WORK PLAN

PERIMETER ESTABLISHMENT: Map/Sketch Attached? Yes Site Secured? A

Perimeter Identified? Yes Zone(s) of Contamination Identified? B

A. Secured sites include: Dead Creek (Queeny to Judith); Sites I, M, N, R.

B. Zones preliminarily identified - investigation incomplete. Assume entire area to to be contaminated.

PERSONAL PROTECTION:

Level of Protection: A ___ B X C X D X

Modifications: MINIMUM protective clothing will include: neoprene boots (steel toe and shank), hooded Tyvek or Saranac coveralls, neoprene gloves, disposable latex booties, disposable latex gloves, hard hats. See attachment for task-specific levels of protection.

Surveillance Equipment and Materials: All field activities will include monitoring with an Hnu (10.2 lamp) or OVA, rad-mini, and cyanide meter or monitox, and an explosimeter/O_2 meter, GCA/MDA real time particulate meter. Optional: MDA/GCA dust monitor will be used if conditions warrant.

PERSONAL PROTECTION (Cont.):

Action Levels:

OVA/Hnu - 0 ppm above background - Level D

1 - 5 ppm above background - Level C

6 - 500 ppm above background - Level B - Contact Regional Safety Coordinator (RSC) prior to upgrade.

>501 ppm above background - Level A

O_2 Meter - <19.5% - Level B, contact RSC.

>25% - Leave area, contact RSC.

Explosimeter - <20% LEL - Continue operation.

20-30% LEL - Identify source, initiate vapor suppressional measures

>30% LEL - Leave area.

Particulate Monitor - >2 mg/m^3 - Initiate dust suppression measures

Monitox CN Monitor - >5 mg/m^3 - Level A, contact RSC.

Rad-mini - Any readings - depart site and contact RSC.

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PERSONAL PROTECTION

The purpose of this attachment is to outline the anticipated levels of protection for each of the objectives in the field investigation phase of this project. Upgrading and downgrading of these levels will be determined in the field based on our readings, weather conditions, and professional judgement. Minimum protective clothing to be worn by any task will include: neoprene boots (steel toe and shank), tyvek or saranax coveralls, disposable gloves and booties, hard hats, and neoprene gloves.

<u>Subsurface Soil Sampling/Well Installation</u>

The present scope of work includes collecting subsurface soil samples at sites G, H, I, J, K, L, and N. Well installation is scheduled for sites G, H, I, O, and Q.

The anticipated level of protection for collection of subsurface samples at sites G, H, I, and L is Level C. This will include racal power air-purifying respirators (APRs) in addition to the protective clothing listed above. It is expected that subsurface sampling at sites J, K, and N will be conducted in Level D. Monitoring with all equipment specified in the safety plan will take place during all drilling activities, and upgrades or downgrades in personal safety measures will be made as necessary. Hearing protection will be worn by personnel working on or near operating drill rig. It is anticipated that drilling and well installation at site Q will be conducted in modified Level B protection. This will include the minimum protective clothing (saranac coveralls) along with self-contained air.

Air will be supplied by a cascade system of air cylinders and run through a manifold system to separate air lines for each team member at the drill rig. The air cylinders will be located on a support vehicle near the drill rig. Drilling and well installation at the remaining sites will initially be conducted in Level C protection.

All levels of protection are based on existing background information. Upgrading and downgrading of these levels will be done in the field using best professional judgement, along with real-time instrumentation readings.

Surface Water/Sediment Sampling

Surface water samples will be collected from creek sectors A-D and Site M using a Kemmerer sampler or by dipping a wide-mouthed glass jar and collecting a grab sample. The anticipated level of protection for all surface water sampling is Level C, which will include racal power APRs along with the minimum protective clothing listed above. Viton or neoprene gloves, taped at the wrist, will also be worn.

Sediment samples will be collected from creek sectors A-D and Site M using a peterson dredge or similar sampling device. The anticipated level of protection is as outlined above for surface water sampling. The need for upgrades or downgrades will be determined in the field using best professional judgement, along with real-time instrumentation readings.

Surface Soil Sampling

Surface soil samples will be collected from sites G and J. Level C protection is anticipated to be sufficient for surface soil sampling at both sites. Racal power APRs will be worn in addition to the minimum protective clothing noted above. Upgrades will be determined in the field using best professional judgement, along with real-time instrumentation readings.

Groundwater Sampling

Groundwater samples will be collected from new monitoring wells at sites G, H, I, O, and Q; from existing monitoring wells in the vicinity of sites G, H, and L; and from residential wells to be determined.

Sampling of all monitoring wells is anticipated to be conducted in Level C protection. This will include racal power APRs and viton or neoprene gloves in addition to the minimum protective clothing. Residential well samples will be collected from existing plumbing in Level D protection. Upgrading and downgrading of these levels will be determined in the field as necessary, and downgrading will be cleared through the safety coordinator.

Soil Gas Monitoring/Air Investigation

Soil gas monitoring will be conducted at sites G, H, I, J, K, L, M, and N in addition to all creek sectors. The soil gas survey will consist of pounding a small diameter well point into the ground with a special cylindrical hammer, followed by pumping air from the well point into collection bags. Analysis of samples will then be completed using an OVA.

It is anticipated that all soil gas monitoring will be conducted in Level C protection, including racal power APRs in addition to the minimum protective clothing.

The air investigation will consist of surveying all sites to identify potential point sources. This will be followed by more detailed sampling of any "hot spots" encountered. All air investigations done in off-site areas are expected to be conducted in Level A protection as above, with upgrades to be determined in the field. On-site air investigations will be conducted in conjunction with other field activities (surface and subsurface soil sampling), and the level of protection will be as outlined above for these activities.

SPECIAL SITE CONSIDERATIONS: See attachment.

DECONTAMINATION PROCEDURES:

Personal: Disposable protective clothing will be bagged, labeled, and drummed. Boot and glove wash with TSP and water. Formal hot line set up necessary.

Equipment: TSP & water wash with rinse as necessary. Sampling equipment: TSP-water wash followed by solvent rinse (acetone-hexane-acetone)/DI water rinse. All drilling equipment (augers, split spoons...) to be steam-cleaned. Air lines will be decontaminated in the following manner: internal - lines will be purged with Grade D or E quality air; external - TSP-water wash and rinse, as necessary.

INVESTIGATION - DERIVED MATERIAL DISPOSAL: (Note - If material is proposed to be left on site, written authorization is to be received by the Project Team Leader prior to the initiation of on site activities): Drill cuttings, purge water will be containerized and moved inside Dead Creek fence. Other disposables will be bagged, labeled, and containerized prior to moving inside Dead Creek fence.

SITE ENTRY PROCEDURES: Decontamination station will be determined each day based on weather conditions. Entry procedures will include ambient air monitoring with surveillance equipment.

Team Member	Responsibility
Dan Sewall	Team Leader
*	Safety Officer TBA
*	TBA
*	TBA
Drillers/subcontractor personnel	

*Additional members to be determined. Project log book will include team members and dates present for all field activities. All subcontractor personnel are to provide SSC with written certification of medical approval, training status, and ability to wear specified respiratory equipment.

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SPECIAL SITE CONSIDERATIONS

Prior to initiating drilling local utilities will be contacted to define subsurface transmission lines. Maneuverability is limited in Dead Creek area north of Judith Lane. Care should be taken to minimize stressful conditions resulting from extreme temperatures. Heat stress/cold stress symptoms will be monitored and recorded in the SSC's log book. Work will be conducted during daylight hours only.

E. EMERGENCY INFORMATION

(Use Supplemental Sheets if Necessary)

EMERGENCY PRECAUTIONS

Acute Exposure Symptoms	First Aid
Chlorotoluene: Severe irritation of skin and respiratory system	Wash irritated areas with water; get medical aid
Pentachlorophenol: Dust and vapors irritate skin and mucous membranes - severe coughing and sneezing	Ingestion: Immediately induce vomiting Dermal: Wash affected areas with soap and water
PCB's: Rash and acne from dermal contact	Ingestion: Provide water, induce vomitting
2,3,7,8-TCDD: Acne, skin and eye irritation, respiratory distress	Dermal: Soap and water wash

*See attached hazard evaluation sheets for additional information.

LOCAL RESOURCES
(Name, Address and Phone Number)
LOCAL AREA CODE: 618

Ambulance 332-6600 Sauget Fire Dept.

Hospital Emergency Room 874-7076 Christian Welfare Hospital

Poison Control Center 1-800-252-2022 St. John's Hospital - Springfield

Police (incl. Local, County Sheriff, State) 332-6500 (Sauget), 1-277-3500 (County), 345-1212 (State)

Fire Department 332-6600

Airport 337-6060 Bi-State Parks Airport, Cahokia

Explosives Unit 345-1212 - State Police

Agency Contact (EPA, State, Local, USCG, etc.) 217/782-6760 - Jeff Larsen - IEPA

Local Laboratory 235-1780 - St. Clair Medical Laboratory

Federal Express 314/367-8278; 6181 Aviation Dr., St. Louis Airport

Client Contact Jeff Larson, IEPA - Springfield 217/782-6760

Others IEPA Emergency Response Unit - 217/782-3637
Emergency Services and Disaster Agency - 217/782-7860

SITE RESOURCES

Water Supply 5 gallon collapsible containers will be used.

Telephone Falling Springs Rd. and Queeny Ave.; Rte. 3 and Monsanto Ave.

Radio To be determined.

Other --

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Emergency Contacts

1. Mr. Raymond Harbison (University of Arkansas) .... (501) 661-5766 or 661-5767
   (501) 370-8263 (24 hour)

2. Paul D. Moss, Regional Safety Coordinator/Chicago .... (312) 663-9415 (office)
   (312) 541-6635 (home)

3. Ecology and Environment, Inc., Corporate Safety Director/
   Paul Jonmaire .... (716) 632-4491 (office)
   (716) 631-9530 (Emergency off-Hours)

Medtox Hotline

1. Twenty-four hour answering service - (501) 370-8263

   What to Report:

   o State: "This is an emergency."

   o Your name, region, and site.

   o Telephone number to reach you.

   o Your location.

   o Name of person injured or exposed.

   o Nature of emergency.

   o Action taken.

2. One of three toxicologists (Drs. Raymond Harbison, Glenn Milner, or Robert James) will contact you. Repeat the information given to the answering service.

3. If a toxicologist does not return your call within 15 minutes, call the following persons in order until contact is made:

   E & E Corporate Headquarters (EST 0830-1700) - (716) 632-4491

   a. Twenty-four hour line - (716) 631-9530

   b. Corporate Safety Director - David Dahlstrom (home - (716) 741-2384)

   c. Assistant Corporate Safety Officer - Steve Sherman (home - (716) 688-0084)

Emergency Routes

Directions to Hospital (incl. MAP) Monsanto Ave. east to Monsanto Rd. (19th St. in E. St. Louis) north on 19th St. to Bond Ave., West on Bond Ave. to 15th St., North on 15th St. to King Drive. East on King Dr. to Christian Welfare Hospital. Routes to be driven by designated site personnel prior to initiating on-site operations.

Other To BI State Parks Airport: State Route 50 south to Judith Lane. East on Judith Lane to Cahokia Rd., South on Cahokia Rd. to Julian Ave., East on Julian Ave. to Airport Rd.

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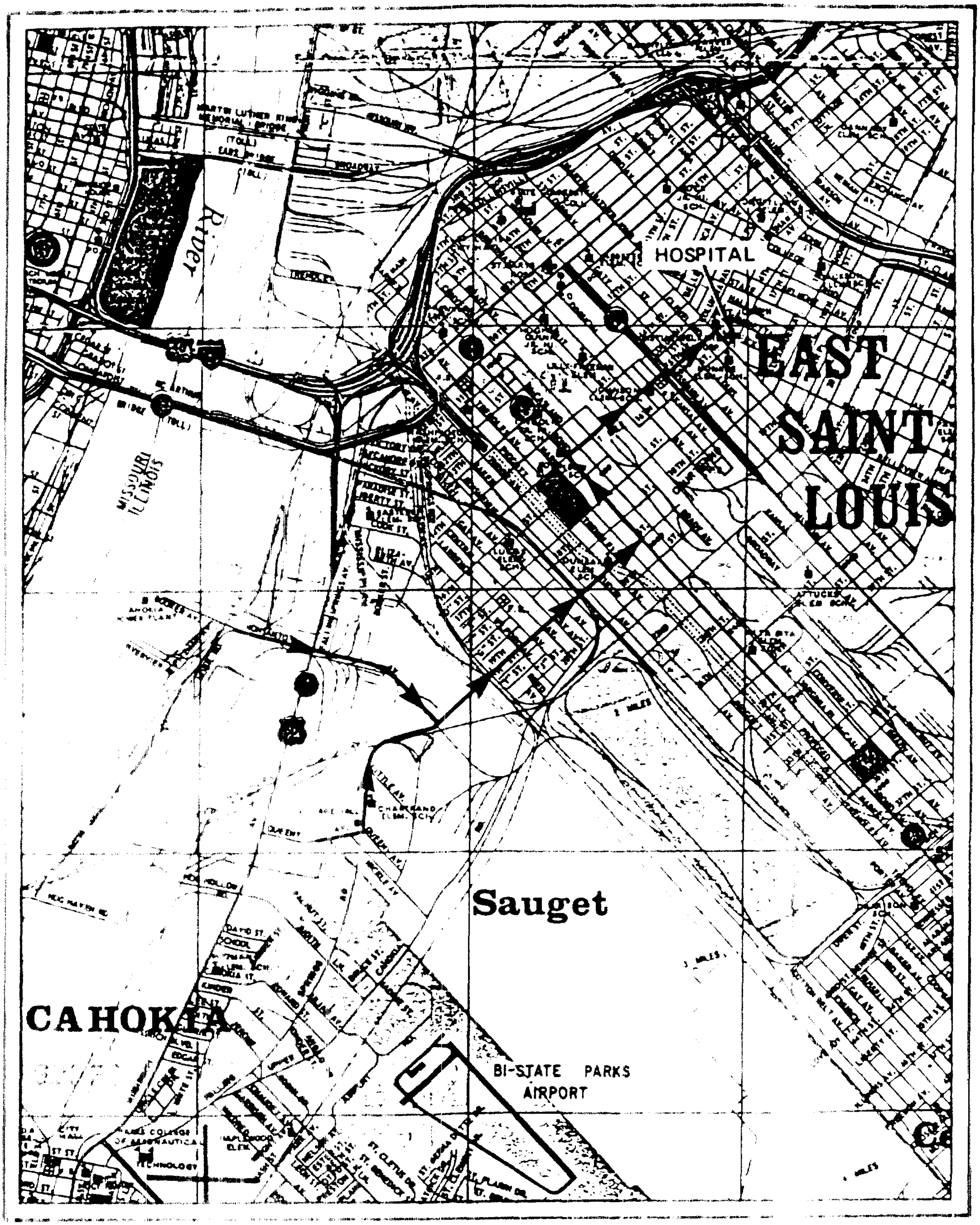

HOSPITAL ROUTES

F. EQUIPMENT CHECKLIST

PROTECTIVE GEAR

LEVEL A

SCBA	
SPARE AIR TANKS	
ENCAPSULATED SUIT (FOR EMERGENCY)	X
SURGICAL GLOVES	
NEOPRENE SAFETY BOOTS	
BOOTIES	
GLOVES (TYPE ____________)	
OUTER WORK GLOVES	
HARD HAT	
CASCADE SYSTEM	
____________	
____________	
____________	
____________	

LEVEL B

SCBA	X
SPARE AIR TANKS	X
CHEMICAL RESISTANT COVERALLS	X
PROTECTIVE COVERALL (TYPE SARANAC (HOODED)	X
RAIN SUIT	X
BUTYL APRON	
SURGICAL GLOVES	X
GLOVES (TYPE VITON)	X
OUTER WORK GLOVES	
NEOPRENE SAFETY BOOTS	X
BOOTIES	X
HARD HAT WITH FACE SHIELD	X
CASCADE SYSTEM	
MANIFOLD SYSTEM	X
AIR COMPRESSOR	X

LEVEL C

ULTRA-TWIN RESPIRATOR	X
RACAL POWER AIR PURIFYING RESPIRATOR	X
RACAL CARTRIDGES (TYPE GMC-H AEP-3) HEPA FILTERS	X
ROBERTSHAW ESCAPE MASK	
CHEMICAL RESISTANT COVERALLS	X
PROTECTIVE COVERALL (TYPE SARANAC (HOODED))	X
RAIN SUIT	X
BUTYL APRON	
SURGICAL GLOVES (LATEX)	X
GLOVES (TYPE VITON - NEOPRENE)	X
OUTER WORK GLOVES	
NEOPRENE SAFETY BOOTS	X
HARD HAT WITH FACE SHIELD	X
LATEX DISPOSABLE BOOTIES	X

LEVEL D

ULTRA-TWIN RESPIRATOR (AVAILABLE)	X
CARTRIDGES (TYPE GMC-H, GM-P)	X
ROBERTSHAW ESCAPE MASK (AVAILABLE)	
CHEMICAL RESISTANT COVERALLS	X
PROTECTIVE COVERALL (TYPE TYVEK, SARANAC)	X
RAIN SUIT	
NEOPRENE SAFETY BOOTS	X
BOOTIES (LATEX)	X
WORK GLOVES	
HARD HAT WITH FACE SHIELD	X
SAFETY GLASSES	X
____________	
____________	
____________	

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INSTRUMENTATION

OVA	X
THERMAL DESORBER	
O2/EXPLOSIMETER	X
EXPLOSIMETER CALIBRATION KIT	X
HNU W/10-2 EV LAMP	X
RAD-MINI	X
MAGNETOMETER	X
PIPE LOCATOR	
WEATHER STATION	X
DRAEGER PUMP	
BRUNTON COMPASS	
HNU CALIBRATION KIT	X
MONITOX CN METER	X
GCA/MDA PARTICULATE MONITOR	X

FIRST AID EQUIPMENT

FIRST AID KIT	X
OXYGEN ADMINISTRATOR	
STRECHER	X
PORTABLE EYE WASH	X
BLOOD PRESSURE MONITOR	X
RADIATION BADGES	X
FIRE EXTINGUISHER	X
THERMOMETERS (OVAL)	X
WALKIE-TALKIE	X

DECON EQUIPMENT

WASH TUBS	X
BUCKETS	X
SCRUB BRUSHES	X
PRESSURIZED SPRAYER	X
DETERGENT (TYPE TSP)	X
SOLVENT (TYPE HEXANE)	X
ACETONE	X

DECON EQUIPMENT (CONT.)

PLASTIC SHEETING	X
TARPS	X
TRASH BAGS	X
TRASH CANS	
MASKING TAPE	X
DUCT TAPE	X
PAPER TOWELS	X
FACE MASK	
FACE MASK SANITIZER	X
FOLDING CHAIRS	X
STEP LADDERS	

SAMPLING EQUIPMENT

To be determined	

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VAN EQUIPMENT		MISCELLANEOUS (CONT.)	
TOOL KIT	___	BINOCULARS	___
HYDRAULIC JACK	___	MEGAPHONE	___
LUG WRENCH	___		
TOW CHAIN	___		
VAN CHECK OUT	___		
GAS	___		
OIL	___		
ANTIFREEZE	___		
BATTERY	___		
WINDSHIELD WASH	___		
TIRE PRESSURE			

MISCELLANEOUS	
PITCHER PUMP	___
SURVEYOR'S TAPE	X
100 FIBERGLASS TAPE	___
300 NYLON ROPE	___
NYLON STRING	___
SURVEYING FLAGS	___
FILM	X
WHEEL BARROW	___
BUNG WRENCH	___
SOIL AUGER	___
PICK	___
SHOVEL	___
CATALYTIC HEATER	___
PROPANE GAS	___
BANNER TAPE	X
SURVEYING METER STICK	___
CHAINING PINS & RING	___
TABLES	___
WEATHER RADIO	X

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HAZARDOUS & TOXIC MATERIALS TEAM
SITE SAFETY REVIEW

GENERAL INFORMATION

DATE ______________ TIME ______________ JOB NO: __________

SITE: ______________________________

LOCATION: ______________________________

ONSITE CLIENT CONTACT: ______________________________

OBJECTIVES: ______________________________

TYPES OF CHEMICALS ANTICIPATED: ______________________________

MEETING CONDUCTED BY: ______________________________

TOPICS DISCUSSED

PHYSICAL HAZARDS: ______________________________

CHEMICAL HAZARDS: ______________________________

PERSONAL PROTECTION: ______________________________

DECONTAMINATION: ______________________________

SPECIAL SITE CONSIDERATIONS: ______________________________

____

____

____

CHECK LIST

1. Emergency information reviewed? and made familiar to all team members?
2. Route to nearest hospital driven and its location known to all team?
3. Site safety plan readily available and its location known to all team members? ____

____

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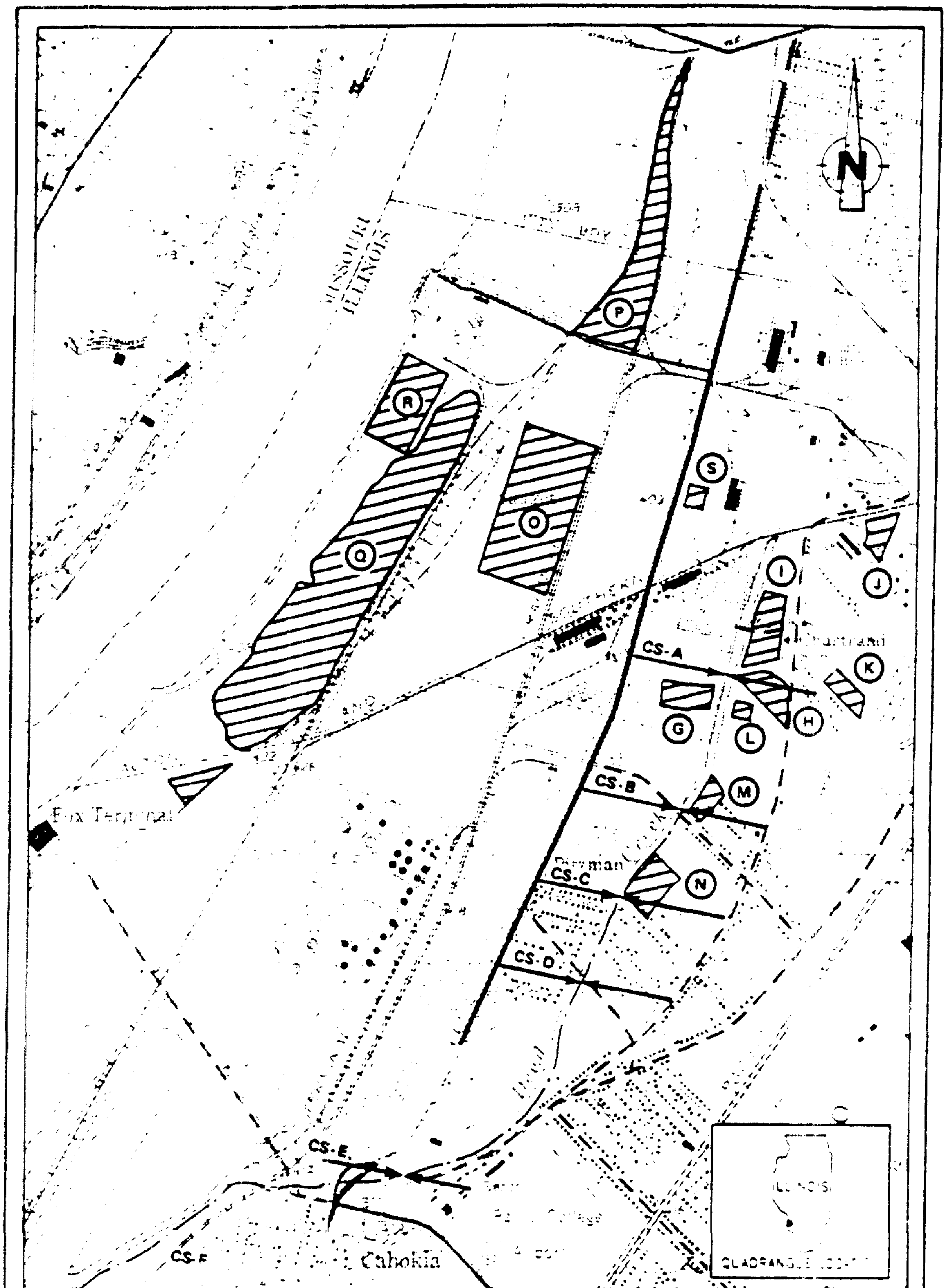

DEAD CREEK PROJECT AREA SITE LOCATION MAP

ecology and environment, inc.

HAZARD EVALUATION OF CHEMICALS

Chemical Name 2,3,7,8 tetrachlorodibenzo- **Date** 9-22-86

DOT Name/U.N. No. None **Job No.** IL-3020

CAS Number 1746-01-6

References Consulted (circle):

NIOSH/OSHA Pocket Guide **(Verschueren)** **(Merck Index)** **Hazardline** **Chris (Vol. II)**

Toxic and Hazardous Safety Manual **ACGIH** **Other:** RTECS

Chemical Properties: **(Synonyms:** Dioxin, TCDD **)**

Chemical Formula $C_{12}H_4O_2Cl_4$ **Molecular Weight** 322 gfw

Physical State Crystalline solid **Solubility** (H_2O) 0.2 **Boiling Point** Decomposes at >1292°F

Flash Point N/A **Vapor Pressure/Density** 1.7×10^{-6} **Freezing Point** N/A

Specific Gravity 1.075 @ 25°C **Odor/Odor Threshold** -- @ 770°F **Flammable Limits** N/A

Incompatibilities Unknown

Biological Properties:

TLV-TWA Not established **PEL** Not established **Odor Characteristic** --

IDLH 22,500 ng/kg **Human** -- **Aquatic** -- **Rat/Mouse** Oral LD_{50} = 22 ug/kg

Route of Exposure Dermal, inhalation, ingestion

Carcinogen Suspected **Teratogen** Animal (RTECS) **Mutagen** Positive (RTECS)

EPA/CDC level in soil is 1 ppb

Handling Recommendations: **(Personal protective measures)**

Supplied air suggested, coated, chemically resistant coveralls, butyl or neoprene boots and gloves. Avoid all contact with skin.

Monitoring Recommendations:

Monitor for dust in the air.

Disposal/Waste Treatment:

Remove from environment and store safely until an approved disposal site can be located (store in sealed, non-reusable containers).

Health Hazards and First Aid: Eyes: Wash immediately with copious amounts of water. Skin: Wash with soap or mild detergent and water. Inhalation: Remove to fresh air (AR if necessary). Ingestion: Give water, then induce vomitting.

Symptoms: **Acute:** Chloracne, skin and eye irritation, fatigue, respiratory distress, mental depression.

Chronic: Chloracne, hepatic neurosis, hemmorrhage, emphysema, liver, thyroid, skin, and kidney carcinogens. CNS depression

375103

(2/83,CLD)

ARSENIC TRICHLORIDE

AST

Common Synonyms	Liquid	Colorless	Unpleasant odor
Fuming liquid arsenic Arsenic chloride Arsenous chloride Caustic arsenic chloride Arsenious chloride Butter of arsenic	Sinks and reacts in water. Poisonous, visible vapor cloud is produced		

AVOID CONTACT WITH LIQUID AND VAPOR. KEEP PEOPLE AWAY.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Not Flammable POISONOUS GASES ARE PRODUCED WHEN HEATED
Exposure	CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED. Move victim to fresh air. If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED. Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE
(See Response Methods Handbook)

Issue warning-poison, water contaminant, corrosive
Restrict access
Disperse and flush

2. LABEL
2.1 Category: Poison
2.2 Class: 6

3. CHEMICAL DESIGNATIONS
3.1 CG Compatibility Class: Not listed
3.2 Formula: $AsCl_3$
3.3 IMO/UN Designation: 6.1/1560
3.4 DOT ID No.: 1560
3.5 CAS Registry No.: 7784-34-1

4. OBSERVABLE CHARACTERISTICS
4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Acrid

5. HEALTH HAZARDS
5.1 Personal Protective Equipment: Safety goggles and face shield; acid-type canister gas mask; rubber gloves; protective clothing.
5.2 Symptoms Following Exposure: Inhalation causes irritation of nose and throat. Contact of liquid with eyes or skin causes severe irritation. Ingestion causes weakness and severe irritation of mouth and stomach. Overdose can cause arsenic poisoning, but symptoms are delayed.
5.3 Treatment of Exposure: Get medical attention after all exposures to this compound. Be alert for arsenic poisoning symptoms. INHALATION: remove to fresh air; give artificial respiration if needed. EYES: flush with water for at least 15 min. SKIN: flush with water. INGESTION: give large amounts of water, then induce vomiting; give lime water, milk, or raw egg; give a cathartic.
5.4 Threshold Limit Value: 0.2 mg/m³ as arsenic
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 3; oral rat LD_{50} = 138 mg/kg; lethal human dose 70-180 mg, depending on weight
5.7 Late Toxicity: Arsenic compounds may be carcinogenic.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS
6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Avoid water on adjacent fires
6.5 Special Hazards of Combustion Products: Irritating and toxic hydrogen chloride formed when involved in fire
6.6 Behavior in Fire: Becomes gaseous and causes irritation. Forms hydrogen chloride (hydrochloric acid) by reaction with water used on adjacent fires.
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Not pertinent

(Continued)

7. CHEMICAL REACTIVITY
7.1 Reactivity With Water: Reacts with water to generate hydrogen chloride (hydrochloric acid)
7.2 Reactivity with Common Materials: Corrodes metal
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Flush with water, rinse with sodium bicarbonate or lime solution.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION
8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION
9.1 Grades of Purity: Commercial
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

6. FIRE HAZARDS (Continued)
6.11 Stoichiometric Air to Fuel Ratio: Not pertinent
6.12 Flame Temperature: Not pertinent

10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)

A-O

11. HAZARD CLASSIFICATIONS
11.1 Code of Federal Regulations: Poison, B
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES
12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 181.3
12.3 Boiling Point at 1 atm: 266.4°F = 130.2°C = 403.4°K
12.4 Freezing Point: 9°F = −13°C = 260°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 2.156 at 25°C (liquid)
12.8 Liquid Surface Tension: (est.) 20 dynes/cm = 0.020 N/m at 20°C
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: 88.31 Btu/lb = 49.06 cal/g = 2.054 X 10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) −18 Btu/lb = −10 cal/g = −0.42 X 10^5 J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 13.3 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

CHRIS, V. III

CADMIUM NITRATE

CMN

Common Synonyms
Cadmium nitrate tetrahydrate

Solid — White — Odorless

Sinks in water

AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY.
Wear a dust respirator.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES MAY BE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.

Exposure

CALL FOR MEDICAL AID.

DUST
POISONOUS IF INHALED.
If inhaled will cause headache, coughing, or difficult breathing.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

SOLID
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
If swallowed will cause nausea and vomiting.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Disperse and flush

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $Cd(NO_3)_2 \cdot 4H_2O$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2570
3.5 CAS Registry No.: 10022-68-

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: White
4.3 Odor: None

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves, safety goggles, dust mask
5.2 Symptoms Following Exposure: Inhalation of fumes can produce coughing, chest constriction, headache, nausea, vomiting, pneumonitis. Chronic poisoning is characterized by emphysema and kidney injury. Ingestion causes gastrointestinal disturbance and severe toxic symptoms; both kidney and liver injuries may occur. Contact with eyes causes irritation.
5.3 Treatment of Exposure: INHALATION: remove patient to fresh air; seek medical attention. INGESTION: give large amounts of water and induce vomiting; give milk or egg whites; seek medical attention. EYES: flush with copious amounts of water for 15 min.; consult a physician. SKIN: wash with soap and water.
5.4 Threshold Limit Value: 0.05 mg/m³ (as cadmium)
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 3; oral mouse LD_{50} = 100 mg/kg
5.7 Late Toxicity: Delayed liver, lung, and kidney damage has followed respiratory exposures to cadmium salts in industry.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Odorless
5.11 IDLH Value: 40 mg/m³ as Cd

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic oxides of nitrogen and cadmium oxide fume may form in fires.
6.6 Behavior in Fire: Will increase intensity of fire when in contact with combustible material.
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: Data not available
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.056 ppm*/**/guppy/LD_{50}/fresh water
0.2 ppm/10 days/stickleback/killed/fresh water
*As cadmium
**Time period not specified
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: Shellfish concentrate 900-1800 times

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

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11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 308.47
12.3 Boiling Point at 1 atm: Not pertinent (decomposes)
12.4 Freezing Point: 138°F = 59°C = 332°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 2.45 at 20°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: 29.7 Btu/lb = 16.5 cal/g = 0.691 X 10^5 J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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p-CHLOROTOLUENE

CRN

Common Synonyms	Liquid	Colorless
p-Tolyl chloride 4-Chloro-1-methylbenzene 4-Chlorotoluene 1-Chloro-4-methylbenzene	Sinks slowly in water	

Avoid contact with liquid. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible. Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	COMBUSTIBLE Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide or dry chemical.
Exposure	CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and induce vomiting.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Restrict access.
Chemical and physical treatment.
Disperse and flush.

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated compound
3.2 Formula: C_7H_7Cl
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2238
3.5 CAS Registry No.: 106-43-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Respirator with proper filter; goggles.
5.2 Symptoms Following Exposure: INHALATION: Irritation of respiratory system. EYES AND SKIN: Severe irritation. INGESTION: Severe internal damage if swallowed.
5.3 Treatment of Exposure: Get medical aid. INHALATION: Move to fresh air. Remove contaminated clothing. Keep warm and quiet. If breathing has stopped give artifical respiration. EYES AND SKIN: Wash with plenty of water. INGESTION: Give one or two glasses of water or milk. Induce vomiting. Give cathartics.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Data not available
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 120°F c.c.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Alcohol foam; CO_2, Dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Data not available
6.5 Special Hazards of Combustion Products: Data not available
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Data not available
6.9 Burning Rate: Data not available
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Data not available
7.2 Reactivity with Common Materials: Data not available
7.3 Stability During Transport: Data not available
7.4 Neutralizing Agents for Acids and Caustics: Data not available
7.5 Polymerization: Data not available
7.6 Inhibitor of Polymerization: Data not available
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: 1-10 ppm/96 hour/Finfish/TL_m
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Data not available
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

AX

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 126.6
12.3 Boiling Point at 1 atm: 324°F = 162°C = 435.2°K
12.4 Freezing Point: 45.5°F = 7.50°C = 280.7°K
12.5 Critical Temperature: Data not available
12.6 Critical Pressure: Data not available
12.7 Specific Gravity: 1.0697 at 20°C
12.8 Liquid Surface Tension: 32.24 dynes/cm = 0.03224 N/m at 25°C
12.9 Liquid Water Interfacial Tension: Data not available
12.10 Vapor (Gas) Specific Gravity: 4.38 (estimated)
12.11 Ratio of Specific Heats of Vapor (Gas): Data not available
12.12 Latent Heat of Vaporization: At boiling point 136.8 Btu/lb = 76 cal/g = 3.18 X 10^5 J/kg
12.13 Heat of Combustion: Data not available
12.14 Heat of Decomposition: Data not available
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Data not available
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

CHRIS, vol. III

o-DICHLOROBENZENE

DBO

Common Synonyms	Liquid	Colorless	Pleasant odor
1, 2-Dichlorobenzene Orthodichlorobenzene Dowtherm E	Sinks in water		

Avoid contact with liquid
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with water, dry chemical, foam, or carbon dioxide. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and pollution control officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: o-$C_6H_4Cl_2$
3.3 IMO/UN Designation: 6.1/1591
3.4 DOT ID No.: 1591
3.5 CAS Registry No.: 95-50-1

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic; characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor-acid gas respirator; neoprene or vinyl gloves; chemical safety spectacles; face shield; rubber footwear; apron; protective clothing.
5.2 Symptoms Following Exposure: Chronic inhalation of mist or vapors may result in damage to lungs, liver, and kidneys. Acute vapor exposure can cause symptoms ranging from coughing to central nervous system depression and transient anesthesia. Irritating to skin, eyes, and mucous membranes. May cause dermatitis.
5.3 Treatment of Exposure: INHALATION: remove victim to fresh air, keep him quiet and warm, and call a physician promptly. INGESTION: no known antidote; treat symptomatically; induce vomiting and get medical attention promptly. EYES AND SKIN: flush with plenty of water; get medical attention for eyes; remove contaminated clothing and wash before reuse.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 50 ppm for 15 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: Causes kidney and liver damage in rats. Effects unknown in humans.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 4.0 ppm; 50 ppm
5.11 IDLH Value: 1,700 ppm

6. FIRE HAZARDS

6.1 Flash Point: 165°F O.C., 155°F C.C.
6.2 Flammable Limits in Air: 2.2%-9.2%
6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating vapors including hydrogen chloride gas, chlorocarbons, chlorine
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 1198°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 1.3 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity:
13 ppm/*/marine plankton/no growth/salt water
*Time period not specified.
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): <0.1% (theor.), 1/5 day
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Technical: 98.5% min. dichlorobenzene (ratio ortho + para/meta, 80 min.) Technical: 85% orthodichlorobenzene, 14.0% paradichlorobenzene Technical: 80% ortho, 17% para, 2% meta Pure: not less than 99.5% ortho, not more than 0.5% para
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 147.01
12.3 Boiling Point at 1 atm: 356.9°F = 180.5°C = 453.7°K
12.4 Freezing Point: 0.5°F = −17.5°C = 255.6°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.306 at 20°C (liquid)
12.8 Liquid Surface Tension: 37 dynes/cm = 0.037 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 40 dynes/cm = 0.04 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.080
12.12 Latent Heat of Vaporization: 115 Btu/lb = 63.9 cal/g = 2.68×10^5 J/kg
12.13 Heat of Combustion: −7980 Btu/lb = −4427 cal/g = -185.4×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 21.02 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.08 psia

NOTES

C. HAIT, VOL-III

2,4-DICHLOROPHENOL

DCP

Common Synonyms	Solid crystals	Colorless	Medicinal odor
	Sinks in water		

Avoid contact with solid and dust. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

SOLID OR DUST
Will burn skin and eyes.
Poisonous if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE
(See Response Methods Handbook)
Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL
2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS
3.1 CG Compatibility Class: Not listed
3.2 Formula: $HOC_6H_3Cl_2$-2,4
3.3 IMO/UN Designation: 6.1/2020
3.4 DOT ID No.: 2020
3.5 CAS Registry No.: 120-83-2

4. OBSERVABLE CHARACTERISTICS
4.1 Physical State (as shipped): Solid
4.2 Color: White
4.3 Odor: Strong medicinal

5. HEALTH HAZARDS
5.1 Personal Protective Equipment: Bureau of Mines approved respirator, rubber gloves, chemical goggles.
5.2 Symptoms Following Exposure: Tremors, convulsions, shortness of breath, inhibition of respiratory system.
5.3 Treatment of Exposure: Inhalation—rest; ingestion—drink water, epsom salt solution.
5.4 Threshold Limit Value: Not pertinent
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Not pertinent
5.9 Liquid or Solid Irritant Characteristics: Fairly severe skin irritant. May cause pain and second-degree burns after a few minutes' contact.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS
6.1 Flash Point: [illegible]°F O.C., 237°F C.C.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Water, foam, carbon dioxide, dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing.
6.5 Special Hazards of Combustion Products: Toxic gases can be evolved.
6.6 Behavior in Fire: Solid melts and burns.
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY
7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: May react vigorously with oxidizing materials
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION
8.1 Aquatic Toxicity:
5 ppm/3 hours/rainbow trout/killed/fresh water
5 ppm/12 hours/bluegills/killed/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 100%, 5 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION
9.1 Grades of Purity: Data not available
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)
[illegible]

11. HAZARD CLASSIFICATIONS
11.1 Code of Federal Regulations: Not listed
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	[illegible]
Flammability (Red)	[illegible]
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES
12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 163.01
12.3 Boiling Point at 1 atm: 421°F = 216°C = 489°K
12.4 Freezing Point: 110°F = 45°C = 318°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.40 at 15°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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LEAD CHLORIDE | LCL

Common Synonyms	Solid	White
Lead dichloride Plumbous chloride Lead (II) chloride	Sinks and mixes with water	

Avoid contact with solid and dust. Keep people away.
Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves).
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Not flammable. POISONOUS METAL FUMES MAY BE PRODUCED IN FIRE. Wear goggles, self-contained breathing apparatus, rubber overclothing (including gloves).
Exposure	CALL FOR MEDICAL AID DUST AND FUMES. POISONOUS IF INHALED. Move to fresh air. Keep victim quiet and warm. SOLID If swallowed, may cause metallic taste, abdominal pain, vomiting and diarrhea. Flush affected area with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk, have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS, do nothing except keep victim warm.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE
(See Response Methods Handbook)
Issue warning - water contaminant
Restrict access
Should be removed
Chemical and physical treatment

2. LABEL
2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS
3.1 CG Compatibility Class: Not listed
3.2 Formula: $PbCl_2$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: Data not available
3.5 CAS Registry No.: 7758-95-4

4. OBSERVABLE CHARACTERISTICS
4.1 Physical State (as shipped): Solid (crystal powder)
4.2 Color: White
4.3 Odor: Data not available

5. HEALTH HAZARDS
5.1 Personal Protective Equipment: Wear approved filter mask, rubber gloves, and safety glasses.
5.2 Symptoms Following Exposure: INHALATION: Joint and muscle pains, headache, dizziness and insomnia. Weakness, frequently of extensor muscles of hand and wrist (unilateral or bilateral). Heavy contamination - brain damage. Stupor progressing to coma - with or without convulsion, often death. Excitation, confusion, and mania less common. Cerebrospinal pressure may be increased. INGESTION: Abdominal pain, diarrhea, constipation, loss of appetite, muscular weakness, headache, blue line on gums, metallic taste, nausea, and vomiting.
5.3 Treatment of Exposure: Call a physician. INHALATION: Remove from source of exposure. Keep victim quite and warm. EYES: Flush with plenty of water. SKIN: Wash with soap and water. INGESTION: Induce vomiting and follow with gastric lavage. Administer saline cathartic and an enema. Give antispasmodic (calcium gluconate, atropine, papaverine) for relief of colic. If pain is severe morphine sulfate may be considered.
5.4 Threshold Limit Value: 0.15 mg/m³ as lead
5.5 Short Term Inhalation Limits: 0.45 mg/m³ as lead
5.6 Toxicity by Ingestion: Guinea pig minimum lethal dose 1500 to 2000 mg/kg.
5.7 Late Toxicity: In man 6 mg/m³/day inhaled long term produces histological and pathological effects. 1.2 mg/day ingested long term produces CNS disorders. Teratogenic effects.
5.8 Vapor (Gas) Irritant Characteristics: Data not available
5.9 Liquid or Solid Irritant Characteristics: Data not available
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS
6.1 Flash Point: Not pertinent
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic metal fumes
6.6 Behavior in Fire: Can emit toxic metal fumes
6.7 Ignition Temperature: Not pertinent
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not pertinent
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY
7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: Data not available
7.3 Stability During Transport: Data not available
7.4 Neutralizing Agents for Acids and Caustics: Data not available
7.5 Polymerization: Data not available
7.6 Inhibitor of Polymerization: Data not available
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION
8.1 Aquatic Toxicity:
5.58 ppm/96-hour/TL_m/Fathead minnow/soft water
482 ppm/96-hour/TL_m/Fathead minnow/hard water
23.8 ppm/96-hour/TL_m/Bluegill/soft water
442 ppm/96-hour/TL_m/Bluegill/hard water
31.5 ppm/96-hour/TL_m/Goldfish/soft water
20.6 ppm/96-hour/TL_m/Guppy/soft water
8.2 Waterfowl Toxicity: Data not available

(Continued)

9. SHIPPING INFORMATION
9.1 Grades of Purity: Data not available
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)
BG

11. HAZARD CLASSIFICATIONS
11.1 Code of Federal Regulations: ORM-B
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES
12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 278.12
12.3 Boiling Point at 1 atm: 1742°F = 950°C = 1223.2°K
12.4 Freezing Point: 933.8°F = 501°C = 774.2°K
12.5 Critical Temperature: Data not available
12.6 Critical Pressure: Data not available
12.7 Specific Gravity: 5.85 at room temperature
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 9.59 (calculated)
12.11 Ratio of Specific Heats of Vapor (Gas): Data not available
12.12 Latent Heat of Vaporization: 191.5 Btu/lb = 106.4 cal/g = 4.45×10^5 J/kg
12.13 Heat of Combustion: Data not available
12.14 Heat of Decomposition: Data not available
12.15 Heat of Solution: Endothermic 40.1 Btu/lb = 22.3 cal/g = 0.93×10^5 J/kg
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 20.3 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

8. WATER POLLUTION (Continued)
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Both fish and animal life can concentrate lead.

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MERCURY

MCR

Common Synonyms	Liquid	Silver	Odorless
Quicksilver	Sinks in water		

AVOID CONTACT WITH LIQUID. Keep people away.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Not flammable
Exposure	CALL FOR MEDICAL AID. LIQUID Effects of exposure may be delayed.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE
(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL
2.1 Category: None

3. CHEMICAL DESIGNATIONS
3.1 CG Compatibility Class: Not listed
3.2 Formula: Hg
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2809
3.5 CAS Registry No.: 7439-97-6

4. OBSERVABLE CHARACTERISTICS
4.1 Physical State (as shipped): Liquid
4.2 Color: Silvery
4.3 Odor: None

5. HEALTH HAZARDS
5.1 Personal Protective Equipment: Avoid contact of liquid with skin. For vapor use chemical cartridge (Hopcalite) respirator.
5.2 Symptoms Following Exposure: No immediate symptoms. As poisoning becomes established, slight muscular tremor, loss of appetite, nausea, and diarrhea are observed. Psychic, kidney, and cardiovascular disturbances may occur.
5.3 Treatment of Exposure: Consult a doctor
5.4 Threshold Limit Value: 0.05 mg/m³
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: No immediate toxicity
5.7 Late Toxicity: Development of mercury poisoning
5.8 Vapor (Gas) Irritant Characteristics: None
5.9 Liquid or Solid Irritant Characteristics: None
5.10 Odor Threshold: Not pertinent
5.11 IDLH Value: 28 mg/m³

6. FIRE HAZARDS
6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not flammable
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY
7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION
8.1 Aquatic Toxicity:
0.5-1 ppm/48 hr/carragius ardium/TL_m/fresh water
0.29 ppm/48 hr/marine fish/TL_m/salt water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: Mercury concentrates in liver and kidneys of ducks and geese to levels above FDA limit of 0.5 ppm. Muscle tissue usually well below the limit.

9. SHIPPING INFORMATION
9.1 Grades of Purity: Pure
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)
A-X

11. HAZARD CLASSIFICATIONS
11.1 Code of Federal Regulations: ORM-B
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES
12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 200.59
12.3 Boiling Point at 1 atm: 675°F = 357°C = 630°K
12.4 Freezing Point: −38.0°F = −38.9°C = 234.3°K
12.5 Critical Temperature: 2664°F = 1462°C = 1735°K
12.6 Critical Pressure: 23,300 psia = 1587 atm = 160.8 MN/m²
12.7 Specific Gravity: 13.56 at 20°C (liquid)
12.8 Liquid Surface Tension: 470 dynes/cm = 0.470 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 375 dynes/cm = 0.375 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 2.7 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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PENTACHLOROPHENOL

PCP

Common Synonyms	
Dowicide 7 Penta Santophen 20	Solid beads or flakes. White to light brown. Sinks in water.

Avoid contact with solid and dust. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Not flammable.
Exposure	CALL FOR MEDICAL AID DUST Irritating to eyes, nose and throat. If inhaled, will cause coughing or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. SOLID POISONOUS IF SWALLOWED. Will burn skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Should be removed

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: C_6Cl_5OH
3.3 IMO/UN Designation: 6.1/2020
3.4 DOT ID No.: 2020
3.5 CAS Registry No.: 87-86-5

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: Colorless to light brown
4.3 Odor: Very weak

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Respirator for dust; goggles; protective clothing.
5.2 Symptoms Following Exposure: Dust or vapor irritates skin and mucous membranes, causing coughing and sneezing. Ingestion causes loss of appetite, respiratory difficulties, anesthesia, sweating, coma. Overexposure can cause death.
5.3 Treatment of Exposure: Call a doctor! INGESTION: induce vomiting at once. EYES: flush with water for 15-20 min. SKIN: wash well with soap and water
5.4 Threshold Limit Value: 0.5 mg/m³
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg (rat)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations.
5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 150 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Not pertinent
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Generates toxic and irritating vapors.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: 1 ppm/3 hr/trout/lethal/fresh water
8.2 Waterfowl Toxicity: 4800 ppm/LC_{50}/mallards
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: 85-100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

B

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-E
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 266.35
12.3 Boiling Point at 1 atm: 590°F = 310°C = 583°K
12.4 Freezing Point: 370°F = 188°C = 461°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.98 at 15°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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POLYCHLORINATED BIPHENYL

PCB

Common Synonyms			
PCB Chlorinated biphenyl Aroclor Halogenated waxes Polychloropolyphenyls	Oily liquid to solid powder Sinks in water	Light yellow liquid, or white powder	Weak odor

Stop discharge if possible. Keep people away.
Avoid contact with liquid and solid.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire	Combustible. Extinguish with water, foam, dry chemical, or carbon dioxide.
Exposure	CALL FOR MEDICAL AID LIQUID OR SOLID Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $(C_{12}H_{10-n})Cl_n$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2315
3.5 CAS Registry No.: 1336-36-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid or solid
4.2 Color: Pale yellow (liquid), colorless (solid)
4.3 Odor: Practically odorless

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Gloves and protective garments.
5.2 Symptoms Following Exposure: Acne from skin contact
5.3 Treatment of Exposure: SKIN: wash with soap and water
5.4 Threshold Limit Value: 0.5 to 1.0 mg/m³
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral rat LD_{50} = 3980 mg/kg
5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 5 to 10 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: > 286°F
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating gases are generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Data not available
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.278 ppm/96 hr/bluegill/TL_m/fresh water
0.005 ppm/336-1080 hr/pinfish/TL_m/salt water
8.2 Waterfowl Toxicity: LD_{50} 2000 ppm (mallard duck)
8.3 Biological Oxygen Demand (BOD): Very low
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-68% by weight)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-E
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.3—1.8 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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PHOSGENE

PHG

Common Synonyms		
Carbonyl chloride Chloroformyl chloride	Liquefied compressed gas	Colorless gas, or light yellow liquid. Sweet or sharp odor

Liquid sinks in water. Poisonous vapor is produced.
Boiling point is 47°F.

AVOID CONTACT WITH LIQUID AND VAPOR. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Evacuate area in case of large discharge.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
POISONOUS IF INHALED.
Irritating to eyes, nose and throat.
Effects may be delayed.
Move to fresh air.
If breathing has stopped, give artificial respiration
but NOT mouth-to-mouth.
If breathing is difficult, give oxygen.
Maintain absolute rest until medical aid arrives.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-poison
Restrict access
Evacuate area

2. LABEL

2.1 Category: Poison
2.2 Class: 2

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $COCl_2$
3.3 IMO/UN Designation: 2.3/1076
3.4 DOT ID No.: 1076
3.5 CAS Registry No.: 75-44-5

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Compressed gas
4.2 Color: Colorless
4.3 Odor: Sharp, pungent odor in higher concentrations, like new-mown grass in low concentrations.

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved U.S. Bureau of Mines respirator; protective clothing.
5.2 Symptoms Following Exposure: Irritates lungs, causing delayed pulmonary edema. Slight gassing produces dryness or burning sensation in the throat, numbness, pain in the chest, bronchitis, and shortness of breath.
5.3 Treatment of Exposure: INHALATION: remove victim from contaminated area, enforce absolute rest, call a doctor.
5.4 Threshold Limit Value: 0.1 ppm
5.5 Short Term Inhalation Limits: 1 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Severe delayed pulmonary edema.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 Liquid or Solid Irritant Characteristics: Severe irritant to all tissues.
5.10 Odor Threshold: 0.5 ppm
5.11 IDLH Value: 2 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable
6.2 Flammable Limits in Air: Not flammable
6.3 Fire Extinguishing Agents: Water to cool containers
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic gas is generated when heated.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Not flammable
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Not flammable
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Decomposes, but not vigorously.
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Can be absorbed in caustic soda solution. One ton of phosgene requires 2,480 lbs. of caustic soda dissolved in 1000 gal of water.
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial: 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Safety relief

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-C-I-J-O

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Poison, A
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	4
Flammability (Red)	0
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 98.92
12.3 Boiling Point at 1 atm: 46.8°F = 8.2°C = 281.4°K
12.4 Freezing Point: −198°F = −128°C = 147°K
12.5 Critical Temperature: 360°F = 182°C = 455°K
12.6 Critical Pressure: 823 psia = 56.0 atm = 5.67 MN/m²
12.7 Specific Gravity: 1.38 at 20°C (liquid)
12.8 Liquid Surface Tension: 22.8 dynes/cm = 0.0228 N/m at 0°C
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: 3.4
12.11 Ratio of Specific Heats of Vapor (Gas): 1.170
12.12 Latent Heat of Vaporization: 110 Btu/lb = 59 cal/g = 2.5×10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

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Common Synonyms	Gas	Colorless	Sweet odor
Chloroethylene VCL Vinyl C Monomer VCM	Liquid floats and boils on water. Flammable, irritating visible vapor cloud is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Evacuate area in case of large discharge.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

Fire	FLAMMABLE. POISONOUS GAS IS PRODUCED IN FIRE. Flashback along vapor trail may occur. May explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Cool exposed containers and protect men effecting shut-off with water. Stop flow of gas if possible. Let fire burn. Extinguish small fires with dry chemical.
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS.
Water Pollution	Not harmful to aquatic life.

1. RESPONSE TO DISCHARGE
(See Response Methods Handbook)
Issue warning-high flammability
Evacuate area

2. LABEL
2.1 Category: Flammable gas
2.2 Class: 2

3. CHEMICAL DESIGNATIONS
3.1 CG Compatibility Class: Vinyl halides
3.2 Formula: $CH_2=CHCl$
3.3 IMO/UN Designation: 2.0/1086
3.4 DOT ID No.: 1086
3.5 CAS Registry No.: 75-01-4

4. OBSERVABLE CHARACTERISTICS
4.1 Physical State (as shipped): Liquefied compressed gas
4.2 Color: Colorless
4.3 Odor: Pleasant, sweet

5. HEALTH HAZARDS
5.1 Personal Protective Equipment: Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate.
5.3 Treatment of Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.
5.4 Threshold Limit Value: 5 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 5 min.
5.6 Toxicity by Ingestion: Not pertinent
5.7 Late Toxicity: Chronic exposure may cause liver damage
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite.
5.10 Odor Threshold: 260 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS
6.1 Flash Point: −110°F O.C.
6.2 Flammable Limits in Air: 4%-26%
6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgene, and carbon monoxide.
6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 882°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4.3 mm/min.

(Continued)

7. CHEMICAL REACTIVITY
7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 35

8. WATER POLLUTION
8.1 Aquatic Toxicity: None
8.2 Waterfowl Toxicity: None
8.3 Biological Oxygen Demand (BOD): None
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION
9.1 Grades of Purity: Commercial or technical 99+%
9.2 Storage Temperature: Under pressure: ambient. At atm. pressure: low
9.3 Inert Atmosphere: No requirement
9.4 Venting: Under pressure: safety relief. At atm. pressure: pressure-vacuum

6. FIRE HAZARDS (Continued)
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: 6.460 (Est.)
6.12 Flame Temperature: Data not available

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10. HAZARD ASSESSMENT CODE
(See Hazard Assessment Handbook)
A-B-C-D-E-F-G-Z

11. HAZARD CLASSIFICATIONS
11.1 Code of Federal Regulations: Flammable gas
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	4
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	0
Aquatic Toxicity	0
Aesthetic Effect	0
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	2

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	4
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES
12.1 Physical State at 15°C and 1 atm: Gas
12.2 Molecular Weight: 62.50
12.3 Boiling Point at 1 atm: 7.2°F = −13.8°C = 259.4°K
12.4 Freezing Point: −244.8°F = −153.8°C = 119.4°K
12.5 Critical Temperature: 317.1°F = 158.4°C = 431.6°K
12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m²
12.7 Specific Gravity: 0.969 at −13°C (liquid)
12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C
12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.2
12.11 Ratio of Specific Heats of Vapor (Gas): 1.186
12.12 Latent Heat of Vaporization: 160 Btu/lb = 88 cal/g = 3.7 X 10^5 J/kg
12.13 Heat of Combustion: −8136 Btu/lb = −4520 cal/g = −189.1 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: −729 Btu/lb = −405 cal/g = −16.9 X 10^5 J/kg
12.25 Heat of Fusion: 18.14 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 75 psia

o-XYLENE

XLO

Common Synonyms	Watery liquid	Colorless	Sweet odor
1,2-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: $o\text{-}C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 95-47-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Benzene-like; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 50 to 500 mg/kg
5.7 Late Toxicity: Kidney and liver damage.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 63°F C.C.; 75°F O.C.
6.2 Flammable Limits in Air: 1.1%-7.0%
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 867°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity:
>100 mg/l/96 hr/D. magna/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 2.5% (theor.), 8 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.7%; Commercial: 95+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 291.9°F = 144.4°C = 417.6°K
12.4 Freezing Point: −13.3°F = −25.2°C = 248.0°K
12.5 Critical Temperature: 674.8°F = 357.1°C = 630.3°K
12.6 Critical Pressure: 541.5 psia = 36.84 atm = 3.732 MN/m²
12.7 Specific Gravity: 0.880 at 20°C (liquid)
12.8 Liquid Surface Tension: 30.53 dynes/cm = 0.03053 N/m at 15.5°C
12.9 Liquid Water Interfacial Tension: 36.06 dynes/cm = 0.03606 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.068
12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47×10^5 J/kg
12.13 Heat of Combustion: −17,558 Btu/lb = −9754.7 cal/g = -408.41×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 30.64 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.26 psia

NOTES

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ecology and environment, inc.

ON-SITE SAFETY LOG

	Background Reading in Breathing Zone	Calibrated At	On-Site Reading in Breathing Zone
A. On-Site Monitoring			
1. HNU/OVA and calibration gas			
2. Rad-mini			
3. Monitox			
4. O_2/Explosimeter and calibration gas			
5. Dust monitor			

B. Protective Clothing Worn: ______________________________

____

____

____

C. Site Name: Dead Creek Project   Project Number: ____________

Date: ____________

Weather Conditions: ____________

Name of Attendees at Site: ______________________________

____

D. Comments on Monitoring or Protective Clothing: ____________

____

____

	Name	Signature
Team Leader:		
Site Safety Officer:		

HISTORY

The study area for the Dead Creek Project (DCP) consists of 18 sites in the towns of Sauget and Cahokia in St. Clair County, Illinois (see attached map). The Illinois EPA became aware of the problems in this area in 1980 when periodic smoldering of materials in a ditch (Dead Creek) was observed. Following an initial inspection, the agency received information that a local resident's dog had come in contact with wastes in the ditch and died of apparent chemical burns.

Historically, during World War II, the study area was heavily developed by industry to support the war effort. Due to this development and the geologic conditions in the area, open pit mining occurred in many areas to supply sand and gravel resources. Following the war, excess product was landfilled and covered in the numerous excavations. Wastes reported to have been buried in these excavations include phosgene gas and munitions in addition to organic and inorganic industrial wastes. The excavated areas were identified by the Illinois EPA from a series of past aerial photographs, and by a thermal infrared survey of the area.

The filling of past excavations was followed by utilization of Dead Creek as receiving water for effluent and surface drainage of various industries. The Illinois EPA performed a preliminary study of the area in 1980, finding excessive levels of organic and inorganic contaminants in and around the creek. Contaminants detected included: PCBs, aliphatic hydrocarbons, dichlorobenzene, lead, cadmium, and arsenic. During the Illinois EPA study, drillers were overcome by organic vapors while installing a monitoring well east of the creek and adjacent to a former seepage lagoon. Sampling of this well and the lagoon indicated high levels of the aforementioned contaminants.

Following World War II, chemical companies in the area returned to normal processes, including the manufacturing of defoliants, pesticides, and herbicides. From the mid-1950s to the early 1970s, the byproducts and wastes from these manufacturing processes were landfilled in the Site R and possibly Site Q areas (see map). Drilling and sampling by E & E in 1983 at Site Q indicated the presence of 63 of the 117 priority pollutants designated by the USEPA, including quantifiable levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Dioxin was also detected in soil samples at Site O. Site P is an Illinois EPA-permitted landfill known to have accepted hazardous waste residues in violation of their permit.

Site G (Inactive Site). Drums and pits observed on the surface. Appear to contain oily wastes (drums - unknown black cinder-like solid).

Contaminants detected in groundwater: PCB (1.0 ppb), chlorophenol (1,200 ppb), chlorobenzene (19 ppb), dichlorobenzene (25 ppb), dichlorophenol (890 ppb), phosphorus (9.4 ppm), and lead (.31 ppm); surface soils: arsenic (16 ppm), lead (2,000 ppm), and PCB (350 ppm).

Depth profiles from creek shows PCB ranging from 9,200 ppm at the surface to 54 ppm at 6 feet.

November 1985 - no readings above background with site entry equipment. Physical hazards - three or four pits with exposed drums, numerous areas mounded with buried drums, poison ivy.

Site H (Inactive Site). Former sand and gravel pit which was filled with construction debris and unknown wastes. Presently covered and well vegetated. Physical hazards - trip and fall. One downgradient well - PCB - 1.0 ppb. No surface soil sampling done. No pits, ponds, etc. on-site.

Site T (Active Plant Site). Cerro copper property. Holding lagoon on site was formerly head water per Dead Creek. Culvert under New Queeny Avenue was blocked sometime after 1950. G112 only groundwater monitoring point for the site - analysis indicates chlorobenzene and dichlorobenzene, along with metals. Soil samples from areas adjacent to the holding pond indicate PCB (0.3 ppm) and aliphatic hydrocarbons (26 ppm) along with dichlorobenzene (1.7 ppm). Also arsenic (95.8 ppm). Surface water samples from holding pond show: nickel (4.2 ppm), arsenic (0.58 ppm), zinc (30 ppm), PCB (28 ppm), aliphatic hydrocarbons (23,000 ppm).

Plant site: Level D with hardhat, safety glasses, necessary - presently no water in former holding pond. Sand and gravel pit identified from historical aerial photos now filled and covered (parking area for trailers).

Site J (Active Plant Site). Sterling Steel Castings. No previous study done. Aerial photos indicate possible disposal. From visual observation and conversation with plant operator, material disposed of consists of casting sand and slag. (Needs groundwater monitoring). Two pits exist on site approximately 30' deep. Two to three drums are evident along the sides. Site also has an inactive incinerator. Possible contaminants include epoxy resins, heavy metals.

Site K (Residential Commercial). No information exists for this site. Historical aerial photos indicate possible dumping. Presently, trailer homes and a small trucking company occupy the property.

Site L (Active Equipment Repair Site). Historical photos indicate a small surface impoundment once existed on the site (Wagganer Trucking). Wagganer was an industrial waste hauler - trucks cleaned on site discharge first into creek, then into impoundment. Wagganer specialized in hauling hazardous materials. Downgradient groundwater analysis: chlorophenol (19 ppb), and cyclohexane (120 ppb). Soils: PCB (5,200 ppm), trichlorobenzne (78 ppm), and hydrocarbons: (21,000 ppm). Presently, site is covered with cinders with no evidence of where the pit was situated.

Site M (Inactive Pit). Hall Const. Pit - site consists of an open pit used for dumping of unknown wastes. Surface soils: PCB, arsenic, and mercury. Surface water: PCB, phosphorus (low levels). Presently, pit is inside fence which surrounds Dead Creek between New Queeeny Avenue and Judith Lane. Steep sloping sides, water present in pit.

Site N (Inactive Construction Site). No historical information is available for this site. Historical photos indicate possible disposal. Presently site is occupied by an inactive construction company. No previous studies performed.

Site O (Active STP). American Bottany wastewater treatment plant. Historically, three lagoons were used for sludge dewatering. Lagoon area is now covered and vegetated. Preliminary sampling indicates PCB, miscellaneous hydrocarbons. No field work proposed for initial phase of study.

Site P (Inactive Permitted Landfill). An IEPA permitted landfill known to have accepted hazardous residues in violation of their permit. Types and quantities of wastes recorded are unknown. No sampling has been done at the site. Presently municipal and construction debris (asbestos) are evident along with cinders, no drums evident. Site is still permitted, though no longer active.

Site Q (Inactive Landfill - Active Transport Facility). Consists of a former unpermitted landfill suspected of receiving hazardous wastes. Located adjacent to the Sauget Toxic Dump. E & E sampling (soil borings) indicated the presence of 63 priority pollutants, including 2,3,7,8-TCDD. No groundwater monitoring has been done at the site - power lines traverse the entire area. Area covered entirely by black cinders. Some refuse (appliances, debris, etc.) randomly dumped in rear portion of property.

Site R (Inactive Landfill). Sauget Toxic Dump - Former chemical dump owned and operated by Monsanto. Contaminants detected in leachate include solvents and 2,3,7,8-TCDD (TAT sampling - 1981). Presently, site is well covered and vegetated. Monsanto tank farm for feedstocks located in the northern portion of the site. No drilling expected. Hard hat and safety glasses required by Monsanto.

PERSONAL PROTECTION

The purpose of this attachment is to outline the anticipated levels of protection for each of the objectives in the field investigation phase of this project. Upgrading and downgrading of these levels will be determined in the field based on our readings, weather conditions, and professional judgement. Minimum protective clothing to be worn by any task will include: neoprene boots (steel toe and shank), tyvek or saranax coveralls, disposable gloves and booties, hard hats, and neoprene gloves.

<u>Subsurface Soil Sampling/Well Installation</u>

The present scope of work includes collecting subsurface soil samples at sites G, H, I, J, K, L, and N. Well installation is scheduled for sites P, Q, and R.

The anticipated level of protection for collection of subsurface samples at sites G, H, I, and L is Level C. This will include racal power air-purifying respirators (APRs) in addition to the protective clothing listed above. It is expected that subsurface sampling at sites J, K, and N will be conducted in Level C. Monitoring with all equipment specified in the safety plan will take place during all drilling activities, and upgrades or downgrades in personal safety measures will be made as necessary. Hearing protection will be worn by personnel work on or near operating drill rig. It is anticipated that drilling and well installation at sites Q and R will be conducted in modified Level B protection. This will include the minimum protective clothing (saranac coveralls) along with self-contained air. Air will be supplied by an air compressor and run through a manifold system to separate air lines for each team member at the drill rig. The air compressor will be located upwind of drilling activities, and will be monitored to ensure proper breathing air is being supplied. Drilling and well installation at Site P will initially be conducted in Level C protection.

All levels of protection are based on existing background information. Upgrading and downgrading of these levels will be done in the field using best professional judgement, along with real-time instrumentation readings.

Surface Water/Sediment Sampling

Surface water samples will be collected from creek sectors A-F and Site M using a Kemmerer sampler or by dipping a wide-mouthed glass jar and collecting a grab sample. The anticipated level of protection for all surface water sampling is Level C, which will include racal power APRs along with the minimum protective clothing listed above. Viton or neoprene gloves, taped at the wrist, will also be worn.

Sediment samples will be collected from creek sectors C, D, E, F, and Site M using a peterson dredge or similar sampling device. The anticipated level of protection is as outlined above for surface water sampling. The need for upgrades or downgrades will be determined in the field using best professional judgement, along with real-time instrumentation readings.

Surface Soil Sampling

Surface soil samples will be collected from sites G, H, I, J, and N. Level C protection is anticipated to be sufficient for surface soil sampling at all sites listed. Racal power APRs will be worn in addition to the minimum protective clothing noted above. Upgrades will be determined in the field using best professional judgement, along with real-time instrumentation readings.

Groundwater Sampling

Groundwater samples will be collected from new monitoring wells at sites P, Q, and R; from existing monitoring wells in the vicinity of sites G, H, and L; and from residential wells to be determined.

Sampling of all monitoring wells is anticipated to be conducted in Level C protection. This will include racal power APRs and viton or neoprene gloves in addition to the minimum protective clothing. Residential well samples will be collected from existing plumbing in Level A protection. Upgrading and downgrading of these levels will be determined in the field as necessary, and downgrading will be cleared through the safety coordinator.

Soil Gas Monitoring/Air Investigation

Soil gas monitoring will be conducted at sites G, H, I, J, K, L, M, and N in addition to all creek sectors. The soil gas survey will consist of pounding a small diameter well point into the ground with a special cylindrical hammer, followed by pumping air from the well point into collection bags. Analysis of samples will then be completed using an OVA.

It is anticipated that all soil gas monitoring will be conducted in Level C protection, including racal power APRs in addition to the minimum protective clothing.

The air investigation will consist of surveying all sites to identify potential point sources. This will be followed by more detailed sampling of any "hot spots" encountered. All air investigations done in off-site areas are expected to be conducted in Level A protection as above, with upgrades to be determined in the field. On-site air investigations will be conducted in conjunction with other field activities (surface and subsurface soil sampling), and the level of protection will be as outlined above for these activities.

IL-3020-D1175

APPENDIX D

QUALITY ASSURANCE PROJECT PLAN (QAPP)

DEAD CREEK PROJECT
SAUGET, ILLINOIS

MAY 1986

Prepared for:

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Approved by:

Andrea P. Schuessler
E & E Quality Assurance Officer   Date: 5/14/86

Michael L. Miller
E & E Project Manager   Date: 5/15/86

____
IEPA ~~Region V~~ Project Manager   Date: ______

____
IEPA ~~Region V~~ Quality Assurance Officer   Date: ______

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Official copies and subsequent revisions will be delivered to:

<u>Quality Assurance Officers</u>

IEPA Region V	Karl Reed
E & E	A.P. Schuessler

<u>Project Managers</u>

~~IEPA Region~~ V	J. Larson
E & E	M. Miller

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LIST OF TABLES

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the policies, organization, objectives, functional activities, and specific Quality Assurance (QA) and Quality Control (QC) activities for the Dead Creek project in Sauget, Illinois. The purpose of the program is to ensure that all technical data generated are accurate, representative, and will ultimately withstand judicial scrutiny.

QC consists of a system of checks on field sampling and laboratory analysis (through the use of field blanks, duplicates, documentation of all sample movement, chain of custody records, etc.) to provide supporting information on the quality of the methods employed and the analytical data.

QA consists of overview checking to certify that the QC procedures have been properly implemented to produce accurate data. QA is a supervisory function.

All QA/QC procedures will be in accordance with applicable professional technical standards, United States Environmental Protection Agency (USEPA) requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP is prepared in accordance with all ~~Region V~~ Illinois EPA (IEPA) and USEPA QAPP guidance documents.

The QAPP incorporates the following activities:

- Sample collection, control, chain-of-custody, and analysis;
- Document control;
- Laboratory instrumentation, analysis, and control; and
- Review of project deliverables.

Analytical samples will be collected in the field utilizing standard operating procedures (SOPs) and sent to Ecology and Environment, Inc.'s (E & E's) Analytical Services Center (ASC) for analysis. Duplicates, replicates, and spiked samples will be used to develop estimates of the quality of the analytical data. Field audits will be conducted to verify that proper sampling techniques and chain-of-custody procedures are followed. Field data compilation, tabulation, and analysis will be checked for accuracy. Calculations and other post-field tasks will be reviewed by project personnel.

Equipment used to take field measurements will be maintained and calibrated in accordance with established procedures (see Section 7). Records of calibration and maintenance will be kept by assigned personnel. Field testing and data acquisition will be performed in accordance with standard protocols.

Document control procedures will be used to coordinate the distribution, coding, storage, retrieval, and review of all data collected during the Dead Creek Project. These procedures will ensure safeguarding of any sensitive materials generated or obtained during the study.

2. PROJECT DESCRIPTION

This QAPP was prepared pursuant to the contract issued by the Illinois Environmental Protection Agency (IEPA) to Ecology and Environment, Inc., (E & E) to conduct a Remedial Investigation/ Feasibility Study (RI/FS) in the Dead Creek area in the towns of Sauget and Cahokia in St. Clair County, Illinois. The project area specifically includes various sites in the two towns that were used for industrial waste dumping or as landfills, as well as portions of Dead Creek--a stream that traverses through the project area before flowing into the Mississippi River. The project will be conducted in cooperation with the IEPA Division of Land Pollution Control.

The objective of the sampling and analysis of the Dead Creek Project Area is to define the nature and extent of contamination by investigating air quality, surface and subsurface soils, and groundwater, as well as surface water and sediments in Dead Creek. Sampling will be conducted in 18 areas: six sectors of Dead Creek, designated A through F, and 12 sites, designated G through R. The analytical data resulting from the RI will be used to prepare a Feasibility Study (FS) to determine if remedial actions are necessary and what level and types of actions are required to mitigate the contamination. The field work for the RI is expected to begin in the middle of March 1986 and be completed by the end of May 1986 (approximately 12 weeks).

Samples to be collected from the Dead Creek Project sites include:

- Subsurface soil samples (from borings);
- Groundwater samples; and
- Surface water/sediment samples.

In addition, air quality investigations will be conducted on a routine basis during on-site work. Soil gas measurements will be taken as necessary, but will not exceed 96 specific locations.

Table 2-1 provides a summary of the number of samples to be collected for each of the various sample media, at the various sites. The site locations are shown on Figure 2-1.

Table 2-1

DEAD CREEK PROJECT SAMPLING FOR VARIOUS MEDIA

Sample Medium	Site	Sample Matrix	Number of Samples	Comments
Surface water/sediment	A	Water	3	Grab and composite
" "	B	"	3	" "
" "	C	Water/sediment	2/2	" "
" "	D	" "	1/2	" "
" "	E	" "	3/10	" "
" "	F	" "	4/10	" "
" "	M	" "	2/3	" "
" "	Field QC samples*	" "	5/6	" "
Surface soil	G	Soil	40	Grid (50 foot)
" "	H	"	5	Random
" "	I	"	32	Grid (100 foot)
" "	J	"	5	Random
" "	N	"	3	"
" "	Field QC samples*	"	15	Random
" "	To be determined	"	10	Dioxin
Subsurface soil	G	Soil	10	Composite
" "	H	"	5	"
" "	I	"	15	"
" "	J	"	5	"
" "	K	"	3	"
" "	L	"	4	"
" "	N	"	2	"
" "	Field QC samples*	"	12	"
Groundwater	Existing monitoring wells	Water	12**	Assigned wells
"	Existing residential wells	"	5	" "
"	New monitoring wells	"	20	" "
"	Field QC samples for wells*	"	8	
Total Samples			199 soil/sediment 68 water 96 soil gas***	

*Field QC samples include one duplicate per 10 samples and one blank per day or per shipment if more than one shipment is made per day.

**Actual number of samples to be determined. Only 8 of 12 existing wells have been located. All wells need to be reconstructed prior to sampling.

***See Section 2.6 Soil Gas Survey for specific locations.

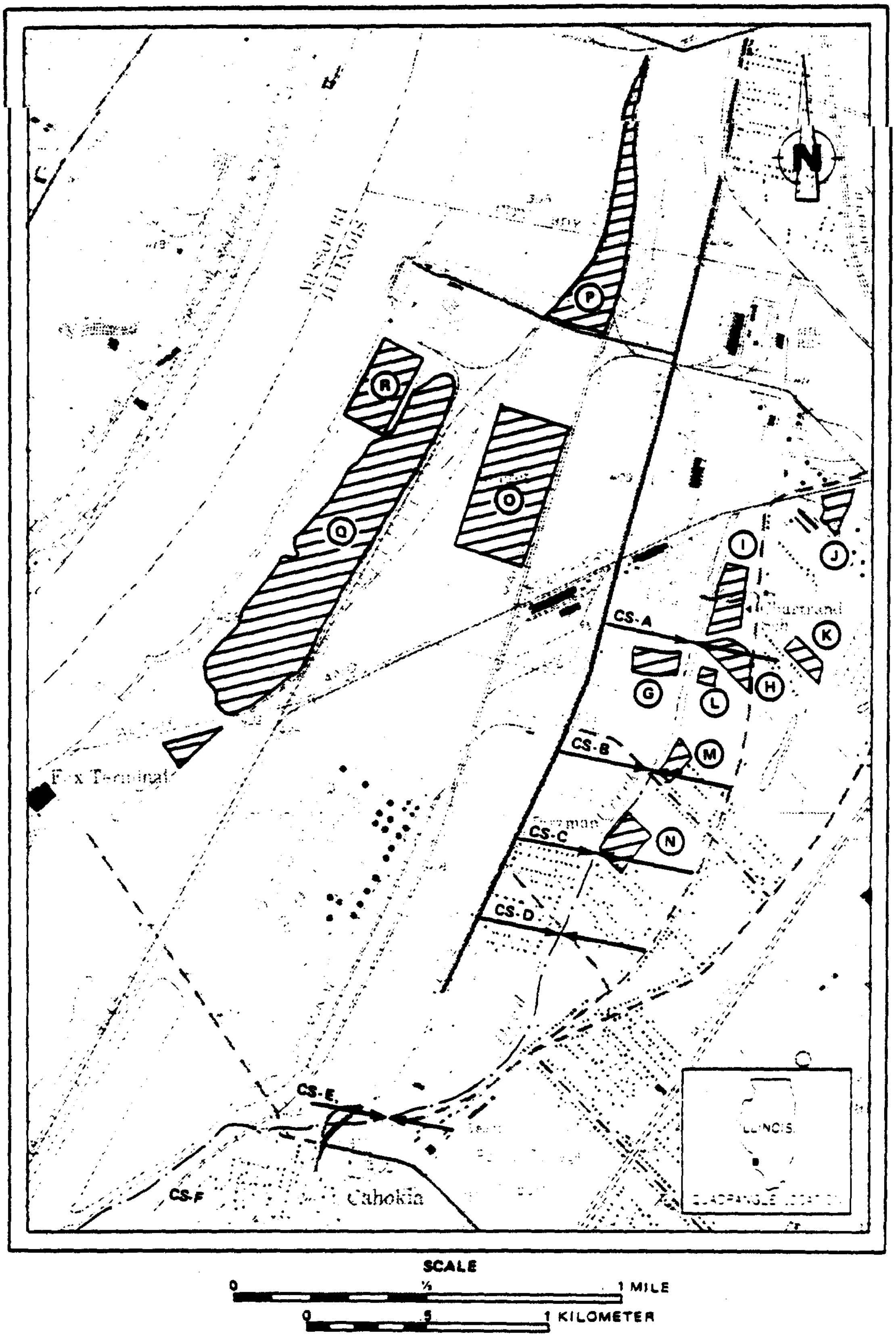

Figure 2–1 DEAD CREEK PROJECT AREA SITE LOCATION MAP

3. PROJECT ORGANIZATION AND RESPONSIBILITY

This QAPP provides for designated QA personnel to review products and provide guidance on QA/QC matters, and outlines the approach to be followed to assure that products of sufficient quality are obtained. In accordance with E & E's corporate QA program, experienced senior technical staff members will be assigned to project QA/QC functions. Figure 3-1 presents the program organization. Figure 3-2 presents the ASC management organization. The management structure provides for direct and constant operational responsibility, clear lines of authority, and the integration of QA activities. The various QA functions are explained below.

IEPA QA/QC Responsibilities

IEPA is responsible for all performance and system audits which include laboratory and field audits, review of QA/QC data validation procedures, as well as intermittent and final review and evaluation of analytical results, including supporting QC data. IEPA conducted initital performance and system audits during July and August 1985.

Project Management

The project management staff consists of IEPA Project Officer J. Larson and E & E project personnel G. Strobel, Project Director; M. Miller, Project Manager; and M. McCarrin, Assistant Project Manager. They are responsible for implementing the project and will have the authority to commit the resources necessary to meet project objectives and requirements. Primary functions are to insure that

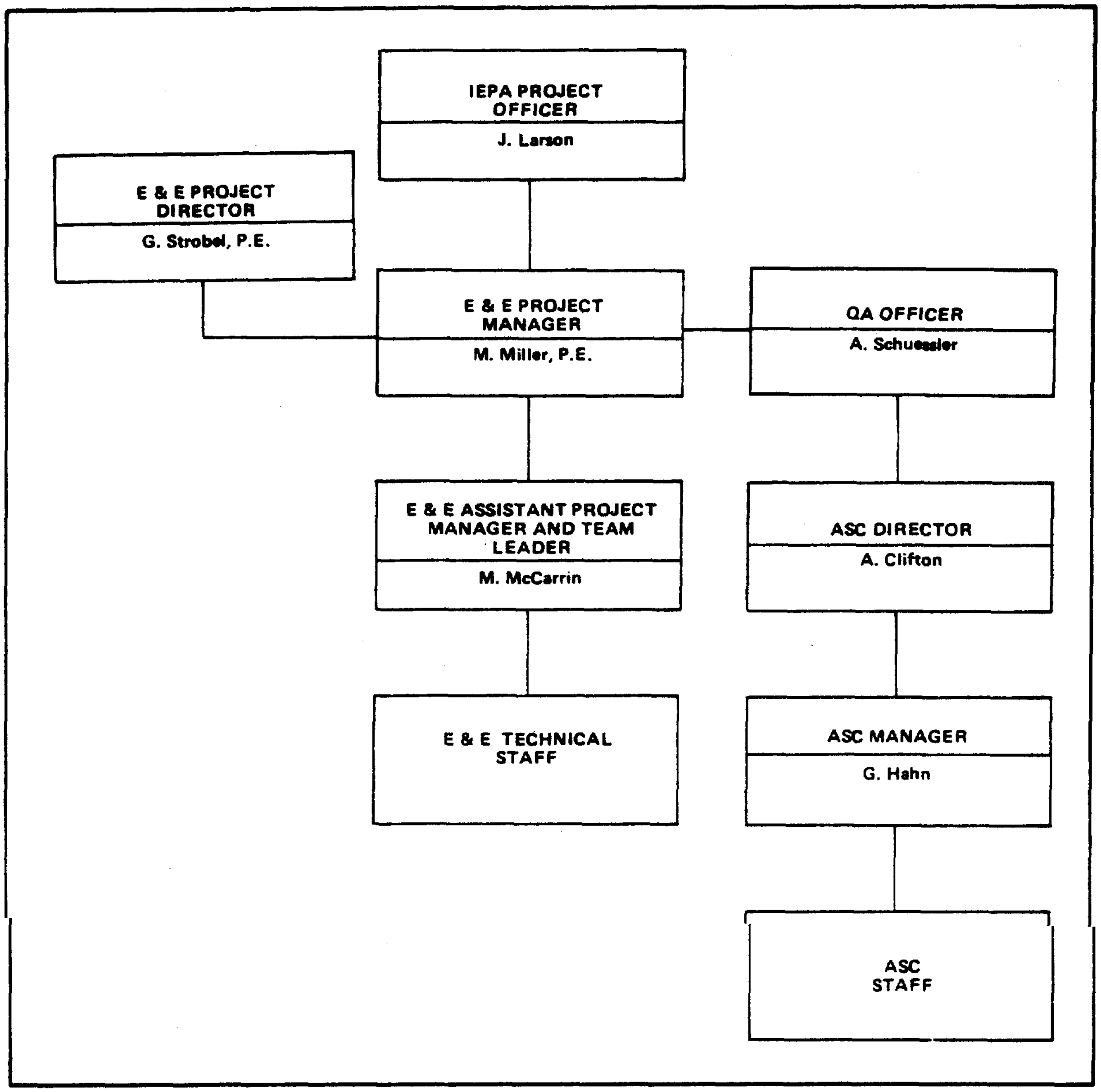

Figure 3—1 QUALITY ASSURANCE PROGRAM ORGANIZATION

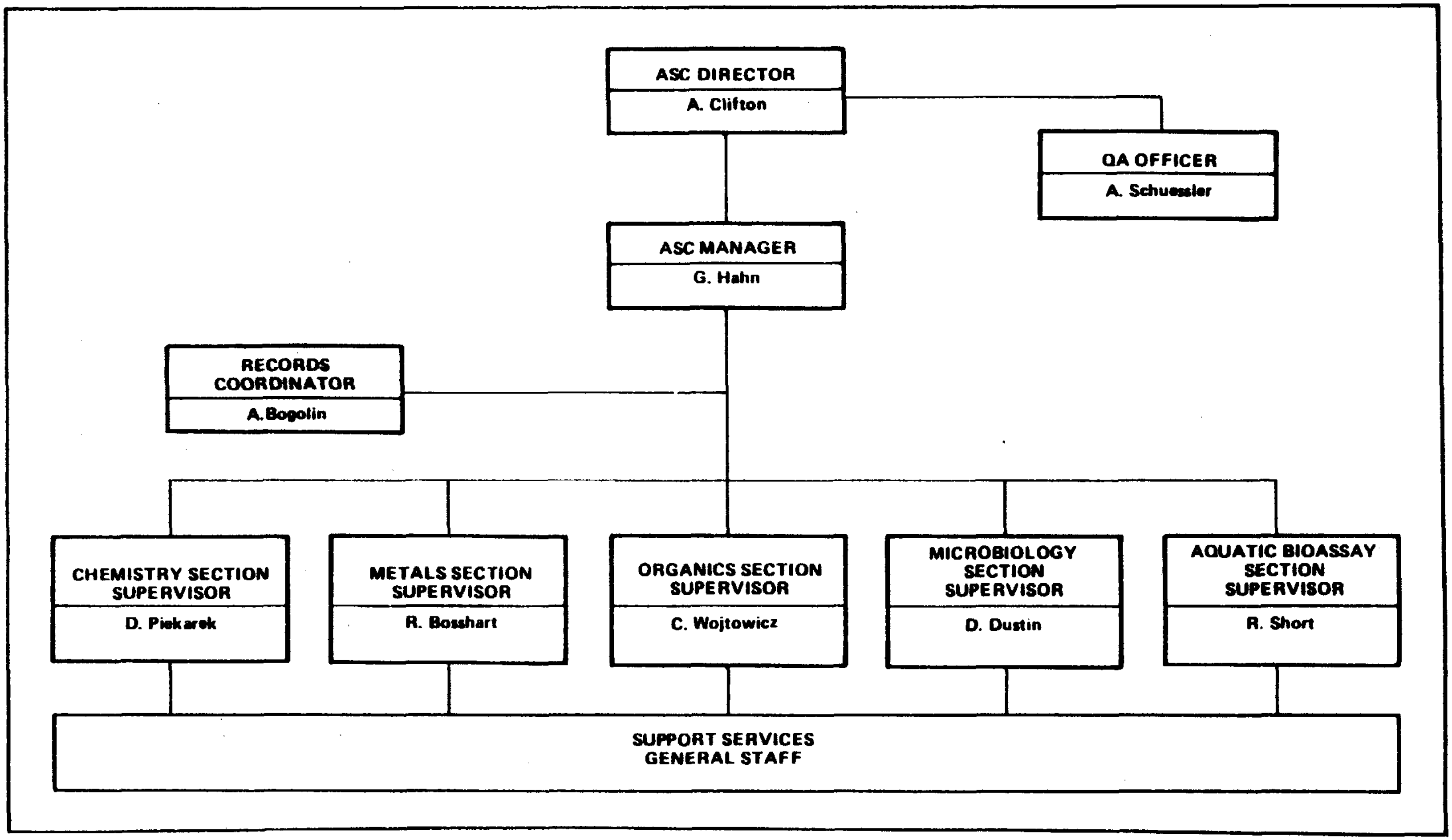

Figure 3–2 ANALYTICAL SERVICES CENTER MANAGEMENT ORGANIZATION

technical, financial, and scheduling objectives are achieved successfully. With full responsibility and authority for project performance, they will:

- Define project objectives and develop a detailed work plan and schedule;
- Establish project policy and procedures to address the specific needs of the Dead Creek project as a whole, as well as the objectives of each task;
- Acquire and apply technical, corporate, and/or subcontractor resources as needed to insure performance within budget and schedule constraints;
- Orient all team leaders and support staff concerning the project's special considerations;
- Monitor and direct the team leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to insure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all external Dead Creek project reports (deliverables) before their distribution;
- Ultimately be responsible for the preparation and quality of interim and final Dead Creek project reports; and
- Represent the project team at meetings and public hearings.

Team Leader for Dead Creek Project

The project managers will be supported by a field team leader who will be responsible for leading and coordinating the day-to-day activities of the various resource specialists under his supervision. The team leader is a highly experienced environmental professional who will report directly to the project manager. The Team Leader and Assistant Project Manager assigned to the project is M. McCarrin. Specific team leader responsibilities include:

- Provision of day-to-day coordination with the project manager on technical issues in specific areas of expertise;
- Development and implementation of team-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Coordination and management of team staff;
- Assure compliance with applicable TSCA and DOT regulations for samples requiring dioxin analysis;
- Implementation of QC for technical data provided by the team staff;
- Adherence to work schedules provided by the project manager;
- Authorship, review, and approval of text and graphics required for team efforts;
- Coordination of technical efforts of subcontractors assisting the team;
- Identification of problems at the team level, discussion of resolutions with the project manager, and provision of communication between team and upper management; and
- Participation in the preparation of the final report.

Technical Staff

The technical staff (team members) for this project will be drawn from E & E's pool of corporate resources and from the organizations of the various subcontractors associated with the project. The technical team staff will be utilized to gather data, analyze data, and prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

QA Project Officer

The QA project officer will be A. Schuessler. She is responsible for maintaining quality assurance for the Dead Creek Project. Specific functions and duties include:

- Coordinating client meetings to determine retention time of QA records, storage requirements and facilities, identification of QA records, and time of transfer of QA records to client facilities;

- Providing guidelines and information as required to assist the QA project managers in the planning, development, and implementation of the QA program for their specific projects;

- Assuring that records of investigatory tasks conform to applicable requirements prior to delivery to clients and assuring that necessary corrective actions have been taken;

- Assuring use of the latest approved procedures, checklists, and forms required to implement check or approval functions as may be specified by the appropriate regulatory agency or client; and

- Establishing a project review group to investigate potential nonconformance and corrective actions and recommend measures to prevent recurrence of any nonconformance.

Analytical Services Center (ASC) Director

The ASC director is A. Clifton. He is responsible for all analytical work and works in conjunction with the QA unit. He maintains liaison with the QA officer regarding QA and custody requirements. Specific duties include:

- Maintaining indexed master copies of all laboratory project records and final reports, listing for each project the equipment, instrument methods, nature of project, date project was initiated, current status, name of sponsor, name of project manager, and status of final report;

- Maintaining copies of the methods and safety manual;

- Conducting inspections of projects and keeping written records of the inspections. For projects lasting less than six months, the QA unit conducts at least one inspection. For projects lasting more than six months, inspections are conducted at least every three months;

- Submitting to the project director and the project managers written status reports on the project, noting any problems, recommendations, and corrective actions taken;

- Reviewing all final reports for accuracy; and

- Signing a statement specifying the dates on which QA inspections were made and findings were reported to management and to the project managers.

ASC Manager

The ASC Manager is G. Hahn. He maintains liaison with the ASC director regarding QA elements of specific sample analyses tasks. He reports to the ASC director and works in conjunction with the QA unit. Specific duties include:

- Developing project specific protocols with the laboratory director;

- Insuring that personnel clearly understand their required tasks;

- Insuring that the project is carried out in accordance with the protocol;

- Insuring that all project QA/QC methods are followed;

- Insuring that all data generated during a project are accurately recorded and verified;

- Insuring that any problems reported during the monitoring of a project by the QA unit are reported to the QA director and that corrective actions are taken and documented; and

- Insuring that project protocol, as well as the final report and all the supporting raw data, are transferred to suitable archives upon completion of the project.

ASC Staff

Each member of the ASC staff performs an assigned QA function that is pertinent to and within the scope of his or her knowledge, experience, training, and aptitude. An individual is assigned the responsibility for checking, reviewing, or otherwise verifying that a sample analysis activity has been correctly performed. The following is a breakdown of analytical areas and their assigned personnel.

- GC/MS: Caryn Wojtowicz - Supervisor; Mike Scanlon, Cindy Stempniak, and Lynn Sullivan - Analysts.

- GC: Caryn Wojtowicz - Supervisor; and David Willy - Analyst.

- Metals: Bob Bosshart - Supervisor; Jim Olka and Richard Nagler - Analysts.

- General/Wet: Dietmar Piekarek - Supervisor; and Paul Azzopardi - Technician.

ASC Facilities

E & E maintains a certified chemical and biological laboratory (the ASC) staffed by full-time scientists and technicians and equipped with state-of-the-art instrumentation for the full range of water, waste, air, sediment, and soil quality parameters.

All laboratory work is performed in accordance with guidelines established by USEPA, the Water Pollution Control Federation, and/or the American Society for Testing and Materials (ASTM). When approved protocols do not exist, the ASC staff develops and validates appropriate analytical methods. In addition, QA and QC programs are maintained for the instruments and the analytical procedures used.

E & E's laboratory is certified by the New York State Department of Health for the analysis of drinking water and wastewater, and is approved by the New York State Department of Environmental Conservation for the analysis of samples associated with state-sponsored Superfund activities. In addition, the ASC is contracted to USEPA for the analysis of organic samples under the Contract Laboratory Program (CLP).

Equipment. The ASC is equipped with the most advanced instrumentation for fast, accurate analyses of air, water, and sediment samples. Major instruments include:

- Gas Chromatograph/Mass Spectrometer/Data System (GC/MS/DS), Hewlett Packard Model 5993B, equipped with a disk-based data system and high-speed computer, capillary interface, and jet separator.

- Gas Chromatograph/Mass Spectrometer/Data System (GC/MS/DS), Hewlett Packard Model 5995C, equipped with RTE-6 data system and dual (packed/capillary) column capability.

- Hewlett Packard 5970B Mass Spectral Detector for capillary column operation interfaced to a HP5890 gas chromatograph.

- Hewlett Packard Model 7675A Automated Purge and Trap Sampler.

- Varian Model 3700 Gas Chromatograph (GC) with flame ionization, Hall, and electron capture detectors.

- Varian Vista 6000 GC with electron capture and flame photometric detectors and capillary capability.

- Hewlett Packard 5890 scanning gas chromatograph equipped with electron capture and flame ionization detector.

- Tekmar LSC-2 Liquid Sample Concentrator for volatile organic analysis.

- Varian 4270 Computing Integrator.

- Spectra-Physics Model SP 4100 and SP 4270 Computing Integrators.

- Instrumentation Laboratory Model 457 Fully Automated Atomic Absorption Spectrophotometer including a Model 655 Furnace Atomizer.

- Perkin Elmer 5000 Zeeman Fully Automated Atomic Absorption Spectrophotometer (AAS) with Furnace Atomizer, Zeeman background correction system, and auto sampler.

- Perkin Elmer PE II Inductively Coupled Argon Plasma (ICAP) Spectrometer.

Analytical Capabilities. The ASC is fully equipped for analysis of all types of water, air, and soil samples for chemical contaminants, bacteriological quality, and general characterization. Proven and approved analytical techniques are used, backed up by a rigorous system of QC and QA checks to ensure reliable and defensible data.

Organic analysis is accomplished by GC and/or GC/MS. Liquid, soil, and air samples are analyzed routinely for pesticides, polychlorinated biphenyls, volatile organics, extractable organics, and other groups of compounds as necessary. Facilities for extraction of soil and sludge samples include Soxhlet.

E & E uses two types of instruments for analysis of metals in various matrices: AAS and ICAP. The various AAS techniques include application of flame, furnace, cold vapor, and hydride generation procedures. During sample preparation and analysis, ASC staff are especially careful to avoid the matrix interference effects to which the analysis of solid samples (soil, sediment, and sludge) for trace metals is particularly susceptible. Check standards (either EPA-provided or National Bureau of Standards [NBS]-traceable) are used with each set of prepared samples.

Other instruments in the ASC include a total organic carbon analyzer; specific ion electrodes (fluoride, cyanide, nitrate, ammonia); spectrophotometers; and basic items such as pH and conductivity meters.

Key ASC Personnel

Table 3-1 lists the key individuals from the ASC involved in the QC aspect of the program.

Table 3-1

KEY ASC PERSONNEL

Name	Position	Education
Andrea P. Schuessler	Corporate QA Officer	B.S. Chemistry
Andrew P. Clifton	Director, Analytical Services Center	B.S. Chemistry
Gary E. Hahn	Manager, Analytical Services Center	B.S. Chemistry
Caryn A. Wojtowicz	Organic Analysis Supervisor	B.A. Biology
Robert E. Bosshart	Inorganic Analysis Supervisor	B.S. Chemistry B.A. Administrative and Management Sciences
Anthony E. Bogolin	Reports Coordinator	B.S. Environmental Science/Biolcgy

4. QA OBJECTIVES FOR MEASUREMENT DATA

All measurements will be made to ensure that analytical results are representative of the media and conditions measured. Unless otherwise specified, all data will be calculated and reported in units consistant with other organizations reporting similar data to allow comparability of data bases among organizations. Data will be reported in ug/l and mg/l for aqueous samples and ug/kg and mg/kg for soils.

The characteristics of major importance for the assessment of generated data are accuracy, precision, completeness, representativeness, and comparability. Accuracy and precision goals for the Dead Creek project are included in the QC tables in Section 8 of this document. The characteristics are defined as follows.

4.1 ACCURACY

Accuracy is the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value and is a measure of bias in the system. Accuracy determination for this project will be accomplished through a systematic analysis of Standard Reference Materials (SRMs) for calibration and spiking solutions. Obtained values will be compared to "true" values using accepted statistical techniques to provide continuing verification of analytical accuracy. For additional information on analytical procedures and specific routine procedures for data assessment, refer to Sections 8 and 13 of this document. Tables 4-1 and 4-2 include spike recovery limits for data accuracy.

Table 4-1

CONTRACT REQUIRED SURROGATE SPIKE RECOVERY LIMITS*

Fraction	Surrogate Compound	Low/Medium Water	Low/Medium Soil/Sediment
VOA	Toluene-d_8	88 - 110	81 - 117
VOA	4-bromofluorobenzene	86 - 115	74 - 121
VOA	1,2-dichloroethane-d_4	76 - 114	70 - 121
BNA	Nitrobenzene-d_5	35 - 114	23 - 120
BNA	2-fluorobiphenyl	43 - 116	30 - 115
BNA	p-terphenyl-d_{14}	33 - 141	18 - 137
BNA	Phenol-d_5	10 - 94	24 - 113
BNA	2-fluorophenol	21 - 100	25 - 121
BNA	2,4,6-tribromophenol	10 - 123	19 - 122
Pest	Dibutylchlorendate	(24 - 154)**	(20 - 150)**

*Referenced - USEPA Contract Laboratory Program, revised July 1985.

**These limits are for advisory purposes only. They are not used to determine if a sample should be reanalyzed. When sufficient data becomes available, the USEPA may set performance based contract required windows.

Table 4-2

MATRIX SPIKE RECOVERY LIMITS*

Fraction	Matrix Spike Compound	Water*	Soil/ Sediment
VOA	1,1-dichloroethane	61 - 145	59 - 172
VOA	Trichlorethene	71 - 120	62 - 137
VOA	Chlorobenzene	75 - 130	60 - 133
VOA	Toluene	76 - 125	59 - 139
VOA	Benzene	76 - 127	66 - 142
BN	1,2,4-trichlorobenzene	39 - 98	38 - 107
BN	Acenaphthene	46 - 118	31 - 137
BN	2,4-dinitrotoluene	24 - 96	28 - 89
BN	Pyrene	26 - 127	35 - 142
BN	N-nitroso-di-n-propylamine	41 - 116	41 - 126
BN	1,4-dichlorobenzene	36 - 97	28 - 104
BN	Di-n-butyl phthalate	11 - 117	29 - 135
Acid	Pentachlorophenol	9 - 103	17 - 109
Acid	Phenol	12 - 89	26 - 90
Acid	2-chlorophenol	27 - 123	25 - 102
Acid	2-chloro-3-methylphenol	23 - 97	26 - 103
Acid	4-nitrophenol	10 - 80	11 - 114
Pest	Lindane	56 - 123	46 - 127
Pest	Heptachlor	40 - 131	35 - 130
Pest	Aldrin	40 - 120	34 - 132
Pest	Dieldrin	52 - 126	31 - 134
Pest	Endrin	56 - 121	42 - 139
Pest	4,4'-DDT	38 - 127	23 - 134

*Referenced - USEPA Contract Laboratory Program - revised July 1985.

Note: These limits are for advisory purposes only.

4.2 PRECISION

Precision is the degree of mutual agreement among individual measurements of a given parameter. Precision determination will be accomplished through regular analysis of duplicate or replicate samples. Relative Percent Difference (RPD) will be calculated for all duplicates and replicates analyzed. EPA has established acceptable RPDs for many of the parameters to be analyzed in this project. These will be compared to obtained RPDs to provide a continuing verification of analytical precision. Generally, RPD limits for inorganic parameters include a limit of less than or equal to 20%. Refer to Section 13 of this document for specific routine procedures for data assessment. Tables 4-3 and 4-4 include organic RPD limits for data precision.

4.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Ninety-five percent completeness will be required for each analysis and as an overall project objective.

4.4 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Careful choice and use of appropriate methods will ensure that samples are representative. This is relatively easy with water or air samples, since these components are homogeneously dispersed. In soil and sediment, contaminants are unlikely to be evenly distributed, and thus it is important for the sampler to exercise good judgment when removing a sample.

4.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another.

Table 4-3

WATER MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Fraction	Compound	Relative Percent Difference (RFP)	Spike Recovery (%)
VOA	1,1-dichloroethane	14	61/145
VOA	Trichlorethene	14	71/120
VOA	Chlorobenzene	13	75/130
VOA	Toluene	13	76/125
VOA	Benzene	11	76/127
B/N/A	1,2,4-trichlorobenzene	28	39/98
B/N/A	Acenaphthene	31	46/118
B/N/A	2,4-dinitrotoluene	38	24/96
B/N/A	Pyrene	31	26/127
B/N/A	N-nitroso-di-n-propylamine	38	41/116
B/N/A	1,4-dichlorobenzene	28	36/97
B/N/A	Pentachlorophenol	50	9/103
B/N/A	Phenol	42	12/89
B/N/A	2-chlorophenol	40	27/123
B/N/A	4-chloro-3-methylphenol	42	23/97
B/N/A	4-nitrophenol	50	10/80
Pesticide	Lindane	15	56/123
Pesticide	Heptachlor	20	40/131
Pesticide	Aldrin	22	40/120
Pesticide	Dieldrin	18	52/126
Pesticide	Endrin	21	56/121
Pesticide	4,4'-DDT	27	38/127

*Referenced - USEPA Contract Laboratory Program, revised July 1985.

Table 4-4

SOIL MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Fraction	Compound	Relative Percent Difference (RFP)	Spike Recovery (%)
VOA	1,1-dichloroethene	22	59/172
VOA	Trichlorethene	24	62/137
VOA	Chlorobenzene	21	60/133
VOA	Toluene	21	59/139
VOA	Benzene	21	66/142
B/N/A	1,2,4-trichlorobenzene	23	38/107
B/N/A	Acenaphthene	19	31/137
B/N/A	2,4-dinitrotoluene	47	28/89
B/N/A	Pyrene	36	35/142
B/N/A	N-nitroso-di-n-propylamine	38	41/126
B/N/A	1,4-dichlorobenzene	27	28/104
B/N/A	Pentachlorophenol	47	17/109
B/N/A	Phenol	35	26/90
B/N/A	2-chlorophenol	50	25/102
B/N/A	4-chloro-3-methylphenol	33	26/103
B/N/A	4-nitrophenol	50	11/114
Pesticide	Lindane	50	46/127
Pesticide	Heptachlor	31	35/130
Pesticide	Aldrin	43	34/132
Pesticide	Dieldrin	38	31/134
Pesticide	Endrin	45	42/139
Pesticide	4,4'-DDT	50	23/134

*Referenced - USEPA Contract Laboratory Program, revised July 1985.

5. SAMPLING PROCEDURES

5.1 AIR INVESTIGATION

The air investigation will include:

- Surveying of sites for "hot spot" off-gassing:
- Identifying and quantifying air releases; and
- Determining background contaminant levels.

The air investigation will include two phases: preliminary source identification and remedial air investigation.

A meteorological station will be set up prior to on-site work to provide baseline data concerning wind direction and speed. This information will be used to determine locations for perimeter monitoring. A baseline volatile organic vapor survey will be conducted on the site prior to any sampling effort to identify areas where potential air problems may exist.

Each site then will be surveyed with an HNu, OVA, or other monitoring equipment. Instrument readings will be recorded for subsequent review and analysis. During this baseline survey, the presence and location of any staining on the ground or exposed waste materials will also be noted and recorded in the field logbooks. An assessment of the vegetative cover on each site will also be made to assist in the planning of additional particulate studies. OVA and HNu values will be recorded for further evaluation.

To achieve the optimum level for the presence of volatile organics in the air, the baseline volatile organic vapor survey should be conducted when ambient air conditions would provide the highest levels. Best results will occur when the air temperature exceeds 80°F and the wind speed is below five miles per hour (mph). Additionally, this baseline survey should be preceded by at least several days of warm weather. Upon completion of this baseline survey, the data will be reviewed with respect to historical information collected regarding waste types and disposal practices.

After all the sites have been surveyed, additional work may be scheduled for those sites demonstrating contaminant air releases. This will entail quantifying and qualifying the exact nature of contaminants being released. High-volume particulate samplers (for detecting metals and low or semi-volatile organic compound contaminants) and Tenax tube collectors (for detecting volatile contaminants) will be set up in at least one upwind and two downwind locations from each area to be investigated. Several additional stations may be distributed to identify base levels of contaminants. High-volume filters and Tenax tubes will be shipped to E & E's Analytical Services Center (ASC) for analysis.

Additional air monitoring data can be inferred from the soil gas monitoring investigation. In this study, volatile substances are traced in the vadose zone. Data from this study can be extrapolated to indicate areas of probable emission of contaminants to the air through natural volatilization.

5.2 SURFACE SOIL SAMPLING

Surface soil samples will be collected according to the procedures described below:

- Samples will be collected to a depth not to exceed 1 foot.

- Using a stainless steel coring device, soil samples will be collected from the ground surface.

- The samples will be transferred to an 8-ounce wide-mouth glass container. As many scoops as necessary will be taken until the sampling bottle is filled.

- When tools are to be reused to collect a new sample, they will be decontaminated to avoid cross-contamination.

- Any observable physical characteristics of the soil as it is being sampled (e.g., color, odor, physical state) will be recorded.

- Selected samples will be screened in the field using an OVA. This screening process involves filling a volatile organics bottle half full with sample material and capping the bottle, then heating the bottle in a pan of water, then uncapping the bottle and inserting the OVA probe into the head space and taking a reading.

- When compositing is to be done, it will be done by delineating the areas to be composited and collecting sufficient core samples to characterize the area. Equipment used to collect subsamples for a composite will not need to be decontaminated. However, complete decontamination will be conducted prior to use of tools for another composite. Delineation of the areas will be based on field observations of site scope, soil material, visual observations of contaminants, etc. in the case of the grid sampling, samples will be from within a grid section.

- All pertinent weather information such as air temperature, pressure, wind velocity, sky conditions, and precipitation will be recorded.

5.3 SUBSURFACE SOIL SAMPLING

Subsurface sampling will be conducted using a drill rig with a hollow stem auger. Continuous samples will be collected unless subsurface conditions prevent such sampling. Continuous sampling is done using a 4-inch diameter, 5-foot split-spoon sampler with a catcher at the foot locked into the lead auger flight. Retrieval is accomplished using hex rods through the augers. The sampler is advanced by rotating augers to the desired depth.

If field conditions prevent use of this method, a 2-inch diameter, 18-inch split-spoon will be advanced by conventional methods. This will include attachment of the sampler to an AW rod and a standard 140-pound hammer. Blow counts will be recorded at 6-inch intervals to a total sample depth of 18 inches. Borings will be drilled to depths specified in Section 2.3, unless sample screening dictates stopping at shallower depths.

As samples are retrieved, they will be screened with an OVA and the HNu if deemed necessary. Upon completion of logging, the lithology, the sample will be stored in a clean 8-ounce jar. Compositing will be performed at the hotline.

All drilling and sampling equipment to be reused will be decontaminated as specified in Section 9. When samples are to be composited, mixing will be done using stainless steel containers and tools. These also will be decontaminated between uses. Where possible and appropriate, disposable equipment will be used in order to minimize cross contamination. Prior to the start of the sampling work, all drilling tools and equipment will be washed with high-pressure steam equipment and rinsed with solvent (see Section 9).

As noted above, selected samples will be field-screened using an OVA and the HNu. A preliminary survey will be also conducted by "sniffing" the sample with an OVA and the HNu immediately upon opening the sampling tube.

Upon completion of the drilling, the open hole will be backfilled with drill cuttings or grouted. Any deficit of material will be supplied using clean earthen material. When the water table is encountered while drilling or the boring goes below the fill, grout will be used to seal that portion of the boring. Grout will be mixed and pumped from the mud tub through the hollow stem of the auger as the auger is retrieved. The hole will be filled from the top of the grout line to ground level using drill cuttings. Any excess cuttings will be drummed and disposed of in accordance with applicable regulations.

Subsurface Soil Sample Compositing

Compositing of soil samples will be according to the following procedures:

- Each portion from a depth interval to be composited will be thoroughly mixed in its sample container with a stainless steel tablespoon.

- The material will be chopped, mixed, and stirred until it is homogeneous.

- A stainless steel tablespoon will be used to transfer the material to a composite container. A clean stainless steel tablespoon will be dedicated for materials for each composite.

- The composite container will be sealed and labeled as specified in this plan (Section 7.3).

5.4 GROUNDWATER SAMPLING

Sampling of the existing monitoring wells, residential wells, and newly installed monitoring wells will consist of the following three activities:

- Measurement of depth to water level and total depth of the well (to calculate well volume),

- Evacuation of static water (purging), and

- Collection of the sample.

These activities are described below.

5.4.1 Measurement of Water Level and Well Volume

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.

- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.

- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

where:

V = Static volume of well in gallons;

T = Depth of water in the well, measured in feet;

r = Inside radius of well casing in inches; and

0.163 = A constant conversion factor which compensates for r^2 h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).

5.4.2 <u>Purging Static Water</u>

Before a groundwater sample is obtained, the static water must be purged to ensure that a representative groundwater sample is taken. A minimum of three static water volumes will be purged from the well prior to collecting the samples. Purging and sampling will be performed using a stainless steel bailer. Since the water removed from the well during the purging process could contain hazardous materials, it will be containerized, not discharged on the ground.

5.4.3 <u>Sample Collection</u>

Sampling personnel will take precautions against cross contamination when using one sampling apparatus for a series of samples. If possible, "clean" or "background" samples will be taken first. Before and after each sample is taken, the apparatus will be decontaminated as specified. Sample collection procedures are as follows:

- A stainless steel bailer (decontaminated according to the procedures presented in Section 9) will be used to collect the groundwater samples.

- Dedicated bailers will be used for monitoring wells. Residential well samples will be collected from existing plumbing as close as possible to the pump and prior to any water softening apparatus.

- When transferring water from the bailer to sample containers, care will be taken to avoid agitating the sample, which promotes the loss of volatile constituents.

- Samples to be analyzed for metals will be filtered in the field using a .45-micron filter and preserved with nitric acid prior to shipment for analysis. Filtering equipment used will be decontaminated between samples to avoid cross contamination. Field filtration requires particular skill if contamination is to be avoided.

- Any observable physical characteristics of the groundwater (e.g., color, sheen, odor, turbidity,) as it is being sampled will be recorded.

- Weather conditions at the time of sampling will be recorded (e.g., air temperature, sky condition, recent heavy rainfall, drought conditions).

5.5 SURFACE WATER/SEDIMENT SAMPLING

5.5.1 Surface Water Sampling

Surface water samples will be collected according to the following procedures:

- A wide-mouth glass bottle to be used for sampling will be dipped into the creek and rinsed three times and the bottle will then be dipped to collect the sample.

- The sample will be collected in such a manner as to prevent agitation of the water, which promotes the loss of volatile organics and increases the dissolved oxygen content.

- The samples will be transferred into 1/2-gallon glass bottles and 40-ml VOA bottles. The wide-mouth bottle will be refilled as many times as necessary to fill all required bottles.

- The temperature, pH, and specific conductivity of the water will be measured, and current speed/volume will be recorded at the time the sample is taken.

- Any observable physical characteristics of the water (e.g., color, odor, turbidity) as it is being sampled will be recorded.

- Weather conditions at the time of sampling will be recorded, (e.g., air temperature, sky conditions, recent heavy rainfalls, and drought conditions).

5.5.2 Sediment Sampling

Sediment samples will be collected from Dead Creek using a Peterson dredge or stainless steel corers. The sampling procedure will be as follows:

- The Peterson dredge will be decontaminated as specified in Section 9.

- The dredge will be lowered into the creek sediment until sufficient resistance is encountered to release the retainer catch. The dredge will then be withdrawn from the sediments.

- The contents of the dredge will be placed in a clean stainless steel pan and composited. A composite sample of the sediment will be transferred to an 8-ounce jar.

5.6 SOIL GAS SURVEY

Soil gas analyses will be performed along a grid covering a presurveyed area. Results will be compiled and plotted on a site base map. Areas with high readings may be resurveyed at smaller intervals.

One sample will be taken outside the area of contamination to establish background levels.

Experience with soil gas monitoring has shown that the weather conditions most conducive to a successful survey are warm, dry, low-wind conditions following several days of warm to hot weather. The survey will be planned for such conditions.

The survey will consist of three soil gas samples taken at 4, 7, and 10 feet below the surface at each sampling location. Although sample locations have generally been identified, the exact locations will be determined in the field based upon an assessment of field conditions, surface evidence of past dumping practices and contamination, and topographic relief.

The soil gas survey will be conducted using either a slam bar/OVA technique or a perforated drive point/bag method. The slam bar technique uses a steel rod that is driven into the soil with a weight that slides along the top of the rod. The slam bar will be driven into the soil to a depth of three feet or to maximum penetration. When the slam bar is withdrawn, the air in the resultant hole will be analyzed with an OVA for volatile organic compounds.

The primary equipment to be used for the perforated drive point/tube/bag method consists of the following:

1. A miniature well point sampler, 5/8-inch in diameter, stainless steel, with 3/8-inch hollow center. The shaft is tipped with a sharp penetrating point and has a narrow, vertically slotted screen. The internal-thread 2.5-foot sections are driven into the soil using a special cylindrical hammer. Connectors allow hook-up to various types of sample analysis equipment.

2. An OVA for determining the total concentration of organic vapors using a flame ionization detector.

The following procedures will be followed at each of the sampling locations.

1. A decontaminated well point sampler will initially be driven into the soil to a depth of 4 feet at each location.

2. Sample tube fittings will be attached to the samples and one volume of air purged from the system using a syringe or piston displacement device.

3. A sample collection bag will be attached to the system and the bag will be filled using a syringe or piston displacement device. The sample bag will then be carried to a van for analysis.

4. The OVA will be set up and operated in the van to standardize analytical conditions. Bag samples will be allowed to equilibrate with internal van conditions. Once equilibrium has been reached, the bag sample will be connected to the OVA (operated in survey mode) and analyzed for total volatile organic substances. An activated carbon filter will be used to check for the presence of methane. Prior to each set of analyses, the OVA will be "zeroed" in a background area and ambient background readings will be recorded. Temperature readings will be recorded during the background measurement and during the sampling.

5. Depending on field conditions, it may be necessary to substitute a slightly different sample collection and analysis procedure. Should weather and soil conditions preclude the use of the analysis equipment described, the equipment and/or techniques will be modified accordingly. All modifications will be documented and appropriate controls instituted for maintaining sample integrity. In any case, the equivalent of one air volume for each sample and depth will be purged prior to collecting the sample for analysis. If no contaminants are detected in a sample, the sample bags may be reused.

6. Upon completion of sampling at 4 feet, the well point will be blown clear with compressed air (D or E quality) and the well

point will be driven to the next sampling interval (samples will be collected at 4, 7, and 10 feet). Procedures 1 to 5 will be repeated at each interval.

7. Upon completion of sampling at each location, the well point will be withdrawn from the ground and the hole backfilled by injecting a bentonite slurry into it.

8. The well point will be decontaminated as specified in Section 9. The sample analytical equipment tubing will be purged until a stable "zero" or background reading is obtained.

9. All data well point locations and sample results will be recorded in a log book of field activities. Data will be tabulated and plotted on a site base map and used for assessment and planning of future investigative work.

10. A duplicate analysis will be collected after every 20 analyses.

The OVA will be calibrated in accordance with the manufacturer's specifications twice daily, once prior to commencing operations and once after 4 hours of field sampling.

5.7 DECONTAMINATION

Sampling methods and equipment have been chosen to minimize decontamination requirements and the possibility of cross contamination. Any sample tubing, rope, rods, etc., will be disposed of after sampling. Sampling equipment used on more than one location will be decontaminated between locations by following these steps:

- Steam clean (drilling equipment only);
- Scrub with brushes in trisodium phosphate (TSP) solution;
- Rinse with deionized water;
- Rinse with acetone;
- Rinse with hexane;
- Rinse with acetone; and
- Rinse with deionized water.

5.8 SAMPLE CONTAINERS

The volumes and containers required for the sampling activities are included in Tables 5-1 and 5-2. Pre-washed sample containers will be provided by E & E's ASC and prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ SEPTEMBER 1986.

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Table 5-1

SAMPLE CONTAINERS, VOLUMES, PRESERVATION,
AND HOLDING TIMES FOR WATER SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	7 days
Extractable Organics, PCBs, Pesticides	1/2-gallon bottles with Teflon-lined caps	Two (2); total volume approx. 1 gallon; fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days
Metals	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill 7/8 full	Nitric acid to below pH 2 (approx. 1.5 ml Con HNO_3 per liter)	6 months
Cyanides	1-liter polyethylene bottle with polyethylene-lined caps	One (1); fill completely	Sodium hydroxide to pH 12 and cool to 4°C (ice in cooler)	24 hours, if sulfide present; 14 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ September 1986.

Table 5-2

SAMPLE CONTAINERS, VOLUMES, PRESERVATION,
AND HOLDING TIMES FOR SOIL SAMPLES

Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per Sample)	Preservation	Maximum Holding Time
Purgeable (Volatile) Organics	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no air space	Cool to 4°C (ice in cooler)	10 days
Extractable Organics, PCBs, Pesticides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 10 days; analyzed within 30 days
Metals	8-oz. glass jar with Teflon-lined cap	One (1); fill half-full	Cool to 4°C (ice in cooler)	6 months
Cyanides	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	24 hours, if sulfide present;
2,3,7,8 TCDD	8-oz. glass jar with Teflon-lined cap	One (1); fill completely	Cool to 4°C (ice in cooler)	Must be extracted within 5 days; analyzed within 30 days

Note: All sample bottles will be prepared in accordance with USEPA bottle washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ SEPTEMBER 1986.

6. SAMPLE CUSTODY

6.1 STANDARD OPERATING PROCEDURES

This section describes standard operating procedures for sample identification and chain-of-custody. The purpose of these procedures is to ensure that the quality of the samples is maintained during their collection, transportation, and storage through analysis. All chain-of-custody requirements comply with standard operating procedures indicated in USEPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the E & E ASC are presented in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ September 1986.

Sample identification documents must be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents include:

- Field notebooks;
- Sample label;
- Custody seals; and
- Chain-of-custody records.

6.1.1 Chain-of-Custody

The primary objective of the chain-of-custody procedures is to provide an accurate written record that can be used to trace the possession and handling of a sample from the moment of its collection through its analyses. A sample is in custody if it is:

- In someone's physical possession;
- In someone's view;
- Locked up; or
- Kept in a secured area that is restricted to authorized personnel.

Field Custody Procedures

- As few persons as possible should handle samples.

- The sample collector is personally responsible for the care and custody of samples collected until they are transferred to another person or dispatched properly.

- The sample collector will record sample data in the field notebook.

- The site team leader will determine whether proper custody procedures were followed during the fieldwork and decide if additional samples are required.

Sample Tags

Sample tags attached to or affixed around the sample container must be used to properly identify all samples taken in the field. The sample tags are to be placed on the bottles so as not to obscure any QA/QC data on the bottles; sample information must be printed in a legible manner using waterproof ink. Field identification must be sufficient to enable cross-reference with the logbook. For chain-of-custody purposes, all QC samples are subject to exactly the same custodial procedures and documentation as "real" samples.

Chain-of-Custody Record

The chain-of-custody record must be fully completed in duplicate, using black carbon paper where possible, by the field technician who has been designated by the project manager as responsible for sample shipment to the appropriate laboratory for analysis. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations, etc.), the person completing the chain-of-custody record should note these constraints in the "Remarks" section of the custody record.

Transfer of Custody and Shipment

- Samples must be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the record. This record documents sample custody transfer.

- Samples must be dispatched to the ASC for analysis with a separate chain-of-custody record accompanying each shipment. Shipping containers must be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information are entered in the "Remarks" section of the chain-of-custody record.

- All shipments must be accompanied by the chain-of-custody record identifying their contents. The original record accompanies the shipment, and the yellow copy is retained by the site team leader.

- If sent by mail, the package is registered with return receipt requested. If sent by common carrier, a bill of lading is used. Freight bills, Postal Service receipts, and bills of lading are retained as part of the permanent documentation.

Laboratory Custody Procedures. A designated sample custodian accepts custody of the shipped samples and verifies that the sample identification number matches that on the chain-of-custody record. Pertinent information as to shipment, pickup, and courier is entered in the "Remarks" section. The custodian then enters sample identification number data into a bound logbook, which is arranged by a project code and station number.

Custody Seals

Custody seals are preprinted adhesive-backed seals with security slots designed to break if the seals are disturbed. A custody seal is placed over the cap of individual sample bottles by the sampling technician. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) are sealed in as many places as necessary to ensure security. Seals must be signed and dated before use. On receipt at the laboratory, the custodian must check (and certify, by completing logbook entries) that seals on boxes and bottles are intact. Strapping tape should be placed over the seals to ensure that seals are not accidentally broken during shipment.

6.1.2 Documentation

Sample Identification

All containers of samples collected from the Dead Creek project will be identified using the following format on a label or tag fixed to the sample container (labels are to be covered with Mylar tape):

DC-XX-OO/D

- DC - This set of initials indicates the sample is from the Dead Creek project.
- XX - These characters identify the sample location. Actual sample locations will be recorded in the task log.
- O/D - This character will be either "O" for original sample, or "D" for duplicate.

Each sample will be labeled and sealed immediately after collection. To minimize handling of sample containers, labels will be filled out prior to sample collection. The sample label will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with Mylar tape. The sample label will give the following information:

- Date,
- Sample number,
- Sample volume,
- Analysis required,
- pH, and
- Preservation.

Daily Logs

Daily logs and data forms are necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. All daily logs will be kept in a bound waterproof notebook containing numbered pages. All entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason. Corrections will be made according to the procedures given at the end of this section. The daily logs will include a site log and a task log.

The Site Log is the responsibility of the site team leader and will include a complete summary of the day's activity at the site.

The Task Log will include:

- Name of person making entry (signature).
- Names of team members on-site.
- Levels of personnel protection:
  - Level of protection originally used,
  - Changes in protection, if required, and
  - Reasons for changes.
- Time spent collecting samples.
- Weather conditions.
- Documentation on samples taken, including:
  - Sampling location and depth station numbers;
  - Sampling date and time, sampling personnel; and

- Type of sample (grab, composite, etc.), matrix.

- On-site measurement data.
- Field observations and remarks.
- Weather conditions, wind direction, etc.
- Unusual circumstances or difficulties.
- Initials of person recording the information.

Corrections to Documentation

Notebook

As with any data logbooks, no pages will be removed for any reason. If corrections are necessary, these must be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction must be initialed and dated. Most corrected errors will require a footnote explaining the correction.

Sampling Forms

As previously stated, all sample identification tags, chain-of-custody records, and other forms must be written in waterproof ink. None of these documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the corrected information. The incorrect information should not be obliterated. Any subsequent error discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

Photographs

Photographs will be taken as directed by the team leader. Documentation of a photograph is crucial to its validity as a representation of an existing situation. The following information will be noted in the task log concerning photographs:

- Date, time, location photograph was taken,

- Photographer (signature),
- Weather conditions,
- Description of photograph taken,
- Reasons why photograph was taken,
- Sequential number of the photograph and the film roll number, and
- Camera lens system used.

After the photographs have been developed, the information recorded in the field notebook should be transferred to the back of the photographs.

6.1.3 Sample Handling, Packaging, and Shipping

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of the sample but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177.

All chain-of-custody requirements must comply with standard operating procedures in the USEPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the E & E Analytical Services Center (ASC) are presented in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ SEPTEMBER 1986.

Sample Packaging

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers. Custody seals must be affixed.

- The sample volume level can be marked by placing the top of the label at the appropriate sample height, or with a grease pencil. This procedure will help the laboratory to determine if any leakage occurred during shipment. The label should not cover any bottle preparation QA/QC marks.

- All sample bottles must be secured with a custody seal and placed in a plastic bag to minimize the potential for vermiculite contamination.

- Shipping coolers must be partially filled with packing materials to prevent the bottles from moving during shipment.

- The secured sample bottles must be placed in the cooler in such a way as to ensure that they do not touch one another.

- The environmental samples are to be cooled. The use of "blue ice" or some other artificial icing material is preferred. If necessary, ice may be used, provided that it is placed in plastic bags. Ice is not to be used as a substitute for packing materials.

- Any remaining space in the cooler should be filled with inert packing material. Under no circumstances should material such as sawdust, sand, etc., be used.

- A duplicate custody record must be placed in a plastic bag and taped to the bottom of the cooler lid.

Note: The ASC does not knowingly accept samples with high levels of radioactivity or dioxins, or any samples for which ASC handling procedures may be insufficient to protect laboratory employees. Project staff and field staff must take all feasible precautions, including discussions with site officials and company representatives, and site observations to ensure that neither they nor ASC personnel are exposed to unduly hazardous materials. Note that field staff are (in many cases) equipped with personal protection and breathing apparatus not available to ASC personnel.

Shipping Containers

Environmental samples will be properly packaged and labeled for transport and dispatched for analysis to the Ecology and Environment, Inc., Analytical Services Center located at 4285 Genesee Street, Buffalo, New York, 14225. A separate chain-of-custody record must be prepared for each container. The following requirements for shipping containers will be followed.

Shipping containers are to be custody-sealed for shipment as appropriate. The container custody seal will consist of filament tape wrapped around the package at least twice and custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking a seal.

Field personnel will make arrangements for transportation of samples to the ASC. When custody is relinquished to a shipper, field personnel will telephone the ASC custodian (716/631-0360) to inform him of the expected time of arrival of the sample shipment and to advise him of any time constraints on sample analysis. The ASC must be notified as early in the week as possible, and in no case later than 3 p.m. (eastern time zone) on Thursday, regarding samples intended for Saturday delivery. Samples will be retained by the ASC for 30 days after the final report is submitted.

Marking and Labeling

- Use abbreviations only where specified.

  The words "This End Up" or "This Side Up" must be clearly printed on the top of the outer package. Upward pointing arrows should be placed on the sides of the package. The words "Laboratory Samples" should also be printed on the top of the package.

- After a container has been sealed, two chain-of-custody seals are placed on the container, one on the front and one on the back. The seals are protected from accidental damage by placing strapping tape over them.

7. CALIBRATION PROCEDURES AND FREQUENCY

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations as well as criteria set forth in the analytical methodology of the Contract Laboratory Program for organic and inorganic analyses. Operation, calibration, and maintenance will be performed by personnel properly trained in these procedures. Documentation of all routine and special maintenance and calibration information will be maintained in an appropriate logbook or reference file and will be available on request. Table 7-1 lists the major instruments to be used for sampling and analysis.

Laboratory capabilities will be initially demonstrated for instrument and reagent/standards performance as well as accuracy and precision of analytical methodology. Daily GC/MS performance tests will be implemented as required and are referenced in the methods to be used.

Table 7-1

LIST OF MAJOR INSTRUMENTS TO BE USED IN THE DEAD CREEK SAMPLING AND ANALYSIS PROGRAM*

- MSA 260 O_2 Explosimeter
- HNu PI-101 Photoionization Analyzer
- Organic Vapor Analyzer Foxboro (128)
- Temperature/Conductivity Meter - Portable
- Hewlett Packard (HP) 1000 computer with RTE-6 operating system; equipped with Aquarius software for control and data acquisition from up to four gas chromatograph/mass spectrometer (GC/MS) systems; combined Wiley and National Bureau of Standards (NBS) mass spectral library; and data archiving on magnetic tape.
- HP5993 GC/MS equipped with packed columns for analysis of volatile organic compounds.
- HP5995C GC/MS equipped with both packed and capillary columns for analysis of all priority pollutant organic compounds.
- HP5970 Mass Spectral Detector interfaced with an HP5890 GC for capillary column determination of semi-volatile priority pollutant compounds.
- Tekmar LSC-2 Liquid Sample Concentrator for volatile organic analysis.
- Hewlett Packard Model 7675A Automated Purge and Trap Sampler.
- Varian 6000 and 3700 Gas Chromatrographs (total 3) equipped with flame ionization, electron capture, photoionization and Hall detectors as appropriate for various analyses
- Spectra-Physics Model SP 4100 and SP 4270 Computing Integrators.
- Instrumentation Laboratory Model 457 Fully Automated Atomic Absorption Spectrophotometer, including a Model 655 Furnace Atomizer.
- Perkin Elmer 5000Z Fully Automated Atomic Absorption Spectrophotometer (AAS) with Furnace Atomizer and Zeeman background correction system.
- Perkin Elmer PE II Inductively Coupled Argon Plasma (ICAP) Spectrometer.

*Calibrated, maintained, and operated according to manufacturer's specifications and all QC protocols within the appropriate methodology. Both lamps (10.2 eV, 11.7 eV) will be used with the HNu Photoionizer. Isobutylene will be used as the calibration gas. The HNu, the OVA, and the MSA 260 O_2 Explosimeter will be calibrated, at a minimum, before use each day, or as required if field problems arise.

8. ANALYTICAL PROCEDURES

Analytical methods to be utilized for the sampling tasks are referenced in USEPA documents: Contract Laboratory Program - Organic Analysis, Statement of Work (SOW), Multimedia, Multiconcentration, Revised July 1985 and Inorganic Analysis, SOW No. 784, July 1984. In addition, groundwater samples from the five residential wells will be analyzed for low-level volatile organic compounds. The gas chromatographic methods to be utilized are referenced within the following documents: the Determination of Halogenated Chemicals in Water by the Purge and Trap Method, Method 502.1, April 1981; and the Analysis of Aromatic Chemicals in Water by the Purge and Trap Method, Method 503.1, May 1980.

Included in Tables 8-1 through 8-5 are detection limits for the GC/MS and GC organic analysis and inorganic (metals) analysis. Tables 8-6 through 8-8 include QC guidelines for inorganic analysis. Refer to sections 4 and 13 of this document for additional QC information regarding spike recovery and RPD limits. Information on sample containers, preservation, and holding times are presented in Section 5 of this document.

Methodology references contain specific QC criteria associated with the particular methods. These specific requirements include calibration, tuning, and QC samples and are described in detail within the methods. Daily performance tests and demonstration of precision and accuracy are required.

In addition, all analytical staff members will follow E & E protocol as set forth in E & E's Laboratory and Field Personnel

Table 8-1*

DEAD CREEK ORGANIC ANALYSIS HAZARDOUS SUBSTANCE LIST (HSL)

Compound	CAS Number	Detection Limits: Low Water (ug/L)	Detection Limits: Low Soil/Sediment (ug/kg)
Volatiles			
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl chloride	75-01-4	10	10
Chlorethane	75-00-3	10	10
Methylene chloride	75-09-2	5	5
Acetone	67-64-1	5	10
Carbon disulfide	75-15-0	5	5
1,1-dichloroethene	75-35-4	5	5
1,1-dichloroethane	75-35-3	5	5
trans-1,2-dichloroethene	156-60-5	5	5
Chloroform	67-66-3	5	5
1,2-dichloroethane	107-06-2	5	5
2-butanone	78-93-3	10	10
1,1,1-trichloroethane	71-55-6	5	5
Carbon tetrachloride	56-23-5	5	5
Vinyl acetate	108-05-4	10	10
Bromodichloromethane	75-27-4	5	5
1,1,2,2-tetrachloroethane	79-34-5	5	5
1,2-dichloropropane	78-87-5	5	5
trans-1,2-dichloropropene	10061-02-6	5	5
Trichloroethene	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
cis-2,3-dichloropropene	10061-01-5	5	5
2-chloroethyl vinyl ether	110-75-8	10	10
Bromoform	75-25-2	5	5
2-hexanone	591-78-6	10	10
4-methyl-2-pentanone	108-10-1	10	10
Tetrachloroethene	127-18-4	5	5
Toluene	108-88-3	5	5
Chlorobenzene	108-90-7	5	5
Ethyl benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Total xylenes		5	5

*Referenced - USEPA Contract Laboratory Program, revised July 1985.

Note:

Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

Table 8-1 (Cont.)

Compound	CAS Number	Detection Limits: Low Water (ug/L)	Detection Limits: Low Soil/ Sediment (ug/kg)
Semi-Volatiles			
Phenol	108-95-2	10	330
bis(2-chloroethyl) ether	111-44-4	10	330
2-chlorophenol	95-57-8	10	330
1,3-dichlorobenzene	541-73-1	10	330
1,4-dichlorobenzene	106-46-7	10	330
Benzyl alcohol	100-51-6	10	330
1,2-dichlorobenzene	95-50-1	10	330
2-methylphenol	95-48-7	10	330
bis(2-chloroisopropyl) ether	39638-32-9	10	330
4-methylphenol	106-44-5	10	330
N-nitroso-Dipropylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-nitrophenol	88-75-5	10	330
2,4-dimethylphenol	105-67-9	10	330
Benzoic acid	65-85-0	50	1,600
bis(2-chloroethoxy) methane	111-91-1	10	330
2,4-dichlorophenol	120-83-2	10	330
1,2,4-trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
2-methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-trichlorophenol	88-06-2	10	330
2,4,5-trichlorophenol	95-95-4	50	1,600
2-chloronaphthalene	91-58-7	10	330
2-nitroaniline	88-74-4	50	1,600
Dimethyl phthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
3-nitroaniline	99-09-2	50	1,600

Table 8-1 (Cont.)

Compound	CAS Number	Detection Limits: Low Water (ug/L)	Detection Limits: Low Soil/Sediment (ug/kg)
Semi-Volatiles			
Acenaphthene	83-32-9	10	330
2,4-dinitrophenol	51-28-5	50	1,600
4-nitrophenol	100-02-7	50	1,600
Dibenzofuran	132-64-9	10	330
2,4-dinitrotoluene	121-14-2	10	330
2,6-dinitrotoluene	606-20-2	10	330
Diethylphthalate	84-66-2	10	330
4-chlorophenyl phenyl ether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-nitroaniline	100-01-6	50	1,600
4,6-dinitro-2-methylphenol	534-52-1	50	1,600
N-nitrosodiphenylamine	86-30-6	10	330
4-bromophenyl phenyl ether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1,600
Phenanthrene	85-01-8	10	330
Anthracene	120-12-7	10	330
Di-n-butylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Pyrene	129-00-0	10	330
Butyl benzyl phthalate	85-68-7	10	330
3,3'-dichlorobenzidine	91-94-1	20	660
Benzo(a)anthracene	56-55-3	10	330
bis(2-ethylhexyl)phthalate	117-81-7	10	330
Chrysene	218-01-9	10	330
Di-n-octyl phthalate	117-84-0	10	330
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(a)pyrene	50-32-8	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Dibenz(a,h)anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

Note:

Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

Table 8-1 (Cont.)

Compound	CAS Number	Detection Limits Low Water (ug/L)	Detection Limits Low Soil/ Sediment (ug/kg)
Pesticides and Polychlorinated Biphenyls (PCBs)			
alpha-BHC	319-84-6	0.05	8
beta-BHC	319-85-7	0.05	8
delta-BHC	319-86-8	0.05	8
gamma-BHC (lindane)	58-89-9	0.05	8
Heptachlor	76-44-8	0.05	8
Aldrin	309-00-2	0.05	8
Heptachlor Epoxide	1024-57-3	0.05	8
Endosulfan I	959-98-8	0.05	8
Dieldrin	60-57-1	0.10	16
4,4'-DDE	72-55-9	0.10	16
Endosulfan II	33213-65-9	0.10	16
4,4'-DDD	72-54-8	0.10	16
Endosulfan Sulfate	1031-07-8	0.10	16
4,4'-DDT	50-29-3	0.10	16
Endrin Ketone	53494-70-5	0.10	16
Methoxychlor	72-43-5	0.5	80
Chlordane	57-74-9	0.5	80
Toxaphene	8001-35-2	1.0	160
Aroclor-1016	12674-11-2	0.5	80
Aroclor-1221	11104-28-2	0.5	80
Aroclor-1232	11141-16-5	0.5	80
Aroclor-1242	53469-21-9	0.5	80
Aroclor-1248	12672-29-6	0.5	80
Aroclor-1254	11097-69-1	1.0	160
Aroclor-1260	11096-82-5	1.0	160

Notes:

Medium Water Contract Required Detection Limits (CRDL) for Pesticide/PCB HSL Compounds are 100 times the individual Low Water CRDL.

Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide/PCB HSL compounds are 15 times the individual Low Soil/Sediment CRDL.

Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

Table 8-2

METHOD DETECTION LIMITS (MDLs)
FOR SELECTED ORGANOHALIDES

Compound	MDL^A (ug/l)	MDL^B (ug/l)
Methyl chloride	0.01	0.001
Vinyl chloride	0.006	0.01
Methyl bromide	0.1	0.03
Ethyl chloride	0.008	0.003
1,1-dichloroethylene	0.003	0.003
1,1-dichloroethane	0.002	0.003
Methylene chloride*	--	--
cis+trans-1,2-dichloroethylene	0.002	0.002
Chloroform	0.002	0.002
1,2-dichloroethane	0.002	0.002
1,1,1-trichloroethane	0.003	0.001
Carbon tetrachloride	0.003	0.002
Bromodichloromethane	0.002	0.003
Dichloroacetonitrile	0.04	0.04
1,1,2-trichloroethylene	0.0007	0.0006
Chlorodibromomethane	0.005	0.008
1,1,2-trichloroethane	0.007	0.002
1,2-dibromoethane	0.03	0.04
2-chloroethylvinyl ether	0.07	0.02
2-chloroethylethyl ether	0.02	0.01
Bromoform	0.02	0.05
1,1,2,2-tetrachloroethane	0.01	0.004
1,1,2,2-tetrachloroethylene	0.001	0.001
Chlorobenzene	0.001	0.005
1,2-dibromo-3-chloropropane	0.03	0.05

MDL^A - Method detection limit at 99% confidence that the value is not zero.

MDL^B - Estimated method detection limit.

*Average background level for methylene chloride 0.1 ug/L.

Reference - USEPA - The Determination of Halogenated Chemicals in Water by the Purge and Trap Method 502.1, EPA #600/4-81-059, April 1981.

Table 8-3

AROMATIC COMPOUNDS
LOWER LIMITS OF DETECTION

Compound	Lower Limit of Detection (ug/l)*
Benzene	0.02
1,1,2-trichloroethylene	0.01
a-trifluorotoluene	0.02
Toluene	0.02
1,1,2,2-tetrachloroethylene	0.01
Ethylbenzene	0.002
1,chlorocyclohexene-1	0.008
p-xylene	0.002
Chlorobenzene	0.004
m-xylene	0.004
o-xylene	0.004
Iso-propylbenzene	0.005
Styrene	0.008
n-propylbenzene	0.009
tert-butylbenzene	0.006
o-chlorotoluene	0.008
Bromobenzene	0.002
sec-butylbenzene	0.02
1,3,5-trimethylbenzene	0.003
p-cymene	0.009
1,2,4-trimethylbenzene	0.006
p-dichlorobenzene	0.006
m-dichlorobenzene	0.006
n-butylbenzene	0.02
2,3-benzofuran	0.03
o-dichlorobenzene	0.02
Hexachlorobutadiene	0.02
1,2,4-trichlorobenzene	0.03
Naphthalene	0.04
1,2,3-trichlorobenzene	0.03

*Lower Limit of Detection - 99% confidence that the value is not zero calculated from 7 runs at 0.04 ug/l.

Reference - USEPA - The Analysis of Aromatic Chemicals in Water by the Purge and Trap Method 503.1, EPA #600/4-81-057, May 1980.

Table 8-4*

ELEMENTS DETERMINED BY INDUCTIVELY COUPLED
PLASMA EMISSION OR ATOMIC ABSORPTION SPECTROSCOPY

Element	Contract Required Detection Level (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5,000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	5
Magnesium	5,000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5,000
Selenium	5
Silver	10
Sodium	5,000
Thallium	10
Tin	40
Vanadium	50
Zinc	20

*Referenced - USEPA Contract Laboratory Program, July 1984.

Table 8-5*

CYANIDE DETERMINATION

Element	Contract Required Detection Level (ug/L)
Cyanide	10

*Referenced - USEPA Contract Laboratory Program, July 1984.

Table 8-6*

INITIAL AND CONTINUING CALIBRATION VERIFICATION
CONTROL LIMITS FOR INORGANIC ANALYSES

		% of True Value (EPA Set)	
Analytical Method	Inorganic Species	Low Limit	High Limit
ICP Spectroscopy/ Flame Atomic Absorption Spectrometry	Metals	90	110
Furnace AA	Metals	90	110
	Tin	80	120
Cold Vapor AA	Mercury	80	120
Other	Cyanide	90	110

*Referenced - USEPA Contract Laboratory Program, July 1984.

Table 8-7*

INTERFERENT AND ANALYTE ELEMENTAL CONCENTRATIONS USED FOR ICP INTERFERENCE CHECK SAMPLE

Analytes	(mg/L)	Interferents	(mg/L)
Silver	0.5	Aluminum	500
Arsenic	1.0	Calcium	500
Barium	0.5	Iron	500
Beryllium	0.5	Magnesium	500
Cadmium	1.0		
Cobalt	0.5		
Chromium	0.5		
Copper	0.5		
Manganese	0.5		
Nickel	1.0		
Lead	1.0		
Antimony	1.0		
Selenium	1.0		
Thallium	1.0		
Vanadium	0.5		
Zinc	1.0		

*Referenced - USEPA Contract Laboratory Program, July 1984.

Table 8-8

INTERFERENT AND ANALYTE ELEMENTAL CONCENTRATIONS
USED FOR INTERFERENCE MEASUREMENTS IN TABLE 8-7*

Analytes	(mg/L)	Interferents	(mg/L)
Aluminum	10	Aluminum	1,000
Arsenic	10	Calcium	1,000
Boron	10	Chromium	200
Barium	1	Copper	200
Beryllium	1	Iron	1,000
Calcium	1	Magnesium	1,000
Cadmium	10	Manganese	200
Cobalt	1	Nickel	200
Chromium	1	Titanium	200
Copper	1	Vanadium	200
Iron	1		
Magnesium	1		
Manganese	1		
Molybdenum	10		
Sodium	10		
Nickel	10		
Lead	10		
Antimony	10		
Selenium	10		
Silicon	1		
Thallium	10		
Vanadium	1		
Zinc	10		

Note: 100 ± 20% recovery required for ICP interference check.

*Referenced - USEPA Contract Laboratory Program, Revised July 1984.

Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, ~~April~~ ATS SEPTEMBER 1986.

9. DATA REDUCTION, VALIDATION, AND REPORTING

QA/QC requirements from both methodology and company protocols will be strictly adhered to during sampling and analytical work. All data generated will be reviewed by comparing and interpreting results from chromatograms (responses, stability of retention times), accuracy (mean percent recovery of spiked samples), and precision (reproducibility of results). Refer to Section 10 for detailed discussion of QA/QC protocol.

All calculations and data manipulations are included in the appropriate methodology references. Control charts and calibration curves will be used to review the data and identify outlying results.

Prior to the submission of the report to the client, all data will be evaluated for precision accuracy and completeness. Specific procedures for data validation are included in Exhibit E: Quality Assurance/Quality Control Requirements, in the CLP Statement of Work as referenced in Section 8 of this document. Sections 4, 8, and 13 of this document include some of the quality control criteria to be utilized in the data validation process.

Data storage and documentation will be maintained using logbooks and data sheets that will be kept on file. Analytical and field QC will be documented and included in the report. The central file will be maintained for the sampling and analytical effort for a period of five years after the final report is issued.

Reports will be reviewed by the laboratory supervisor, the QA officer, ASC manager and/or director, and the project manager. The following information will be included in the analytical reports:

1. Scope and Application

   - Type of analyses, parameters of interest, Method Detection Limits (MDLs), acceptance criteria for precision, accuracy, and completeness

2. Analytical Methods (referenced)

3. Method Blank Analysis

   - Types of impurities and contamination

4. Quality Control

   - Demonstration of competence by meeting limits for acceptance criteria for precision, accuracy, and completeness

   - Records kept and reported with sample results

5. Criteria for Quantitative Identification

   - Results reported in ug/l, ug/kg or mg/l, mg/kg

6. Method Verification

   - Demonstration of precision and accuracy

7. Calibration

   - Internal/external standards used

8. Daily Performance Tests for Instrumentation

   - Tuning and calibration

9. Criteria for Qualitative Identification

- Criteria for positive identification

- Chromatograms

The following information will not be included in the analytical reports but are available within the Sampling Plan, QAPP, and Health and Safety documents for the Dead Creek Project.

10. Safety

    - Detailed summary of safety protocols followed

11. Apparatus and Materials

    - Sampling equipment, instruments used for analysis

12. Reagents

    - Types of reagents used, preparation of standard solutions

13. Sampling

    - Techniques used

14. Sample Preservation and Handling

Figure 9-1 presents a Data flow/reporting scheme.

DATA GENERATED BY ANALYSTS

↓

DOCUMENTED IN LOGBOOKS/DATA SHEETS OR ON MAGNETIC TAPE

↓

DATA APPROVED BY RESPECTIVE LAB SUPERVISOR

↓

DATA TABULATED AND COMPILED INTO REPORT FORMAT
(Job File)

↓

REPORT APPROVED BY RESPECTIVE SUPERVISOR

↓

REPORT APPROVED AND VALIDATED BY QA OFFICER
(Report Package Validated Utilizing CPL Review Criteria)

↓

REPORT APPROVED BY LABORATORY MANAGER

↓

REPORT APPROVED BY PROJECT MANAGER

↓

VALIDATED ANALYTICAL REPORT PACKAGE SUBMITTED TO CLIENT

Figure 9–1 DATA FLOW/REPORTING SCHEME

10. INTERNAL QUALITY CONTROL CHECKS

QC data is necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of glassware and reagents. Laboratory-based QC will comprise at least 10% of each data set generated and will consist of standards, replicates, spikes, and blanks. Depending upon the particular method used, QC may be more rigorous, but at a minimum, one spike or replicate per 10 samples and one method blank per 20 samples or run, whichever is greater, will be utilized for every analytical run. Field duplicates and field blanks will be analyzed by the laboratory as samples and will not necessarily be identified to the laboratory as duplicates or blanks. Split samples in the field will be provided to IEPA upon request to be analyzed independently. Calculations will be performed for recoveries and standard deviations along with review of retention times, response factors, chromatograms, calibration, tuning, and all other QC information generated. All QC data, including split samples, will be documented in the site logbook. QC records will be retained and results reported with sample data. Specific QC requirements for the organic and inorganic analyses are incorporated in USEPA's Contract Laboratory Program, Scope of Work for Organic and Inorganic Analyses.

Blank Samples

Blank samples are analyzed in order to assess possible contamination from the field and/or laboratory so that corrective measures may be taken, if necessary. Blank samples include:

- Field Blanks - These blank samples are exposed to field and sampling conditions and analyzed in order to assess possible contamination from the field.

- Method Blanks - These blank samples are prepared in the laboratory and are analyzed in order to assess possible laboratory contamination.

- Reagent and Solvent Blanks - These blank samples are prepared in the laboratory and analyzed in order to determine the background of each of the reagents or solvents used in an analysis.

Analytical Replicates

Replicate samples are aliquots of a single sample that is split on arrival at the laboratory or upon analysis. Replicates may be made if no duplicates are provided by the field sampling team; however, their purposes are not always interchangeable. Significant differences between two replicates that are split in a controlled laboratory environment usually are due to poor analytical technique.

Calibration Standards

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards are used to generate a standard curve and thereby quantitate the compound in the environmental sample. A minimum of three calibration standards will be used to generate a standard curve for all analyses.

Check Standard

A check standard is prepared in the same manner as a calibration standard or may be obtained from USEPA. The final concentration calculated from the known quantities is the "true" value of the standard. The important difference in a check standard is that it is not carried through the same process used for the environmental samples, but is analyzed without digestion or extraction. A check standard result is used to validate an existing concentration calibration standard file or calibration curve. The check standard can provide information on the accuracy of the instrumental analytical method independent of various sample matrices.

Spike Sample

A sample spike is prepared by adding to an environmental sample (before extraction or digestion), a known amount of pure compound of the same type that is to be assayed for in the environmental sample. These spikes simulate the background and interferences found in the actual samples and the calculated percent recovery of the spike is taken as a measure of the accuracy of the total analytical method. When there is no change in volume due to the spike, it is calculated as follows:

$$\% R = \frac{100\ (0-X)}{T}$$

where, $\% R$ = Percent recovery;

0 = Measured value of analyte; and

X = Measured value of analyte concentration in the sample before the spike is added.

Tolerance limits for acceptable percent recovery are established in the methodology references and presented in Section 8 of this document.

Internal Standard

An internal standard is prepared by adding a known amount of pure compound to the environmental sample; the compound selected is not one expected to be found in the sample, but is similar in nature to the compound of interest. Internal standards are added to the environmental sample just prior to analysis. (Note: Internal standards and surrogate spikes are different compounds. The internal standard is for quantification purposes using the relative response factor;

surrogate spikes indicate the percent recovery and therefore the efficiency of the methodology.)

Matrix Spike/Duplicate

Aliquots are made in the laboratory of the same sample and each aliquot is treated exactly the same throughout the analytical method. Spikes are added at approximately 10 times the method detection limit. The percent difference between the values of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method:

$$\% D = \frac{2 (D_1 - D_2) \times 100}{(D_1 + D_2)}$$

where, $\% D$ = Percent difference,

D_1 = First sample value, and

D_2 = Second sample value (duplicated).

The tolerance limit for percent differences between laboratory duplicates should not exceed 15% for validation in homogeneous samples. Refer to Section 8 for criteria on percent difference. Acceptable percent differences may vary depending on actual levels.

Quality Control Check Samples

Inorganic and organic control check samples are available from USEPA free of charge and are used as a means of evaluating analytical techniques of the analyst.

11. PERFORMANCE AND SYSTEM AUDITS

Performance and system audits include careful evaluation of both field and laboratory quality control. System audits are performed on a regularly scheduled basis during the lifetime of the project to determine the accuracy of the measurement systems.

System audits may be performed through split sampling in the field and issuing the laboratory periodic blind samples. Split samples may be provided and will be documented. The IEPA would compare results of QA split samples analyzed by an independent laboratory with analogous results obtained by E & E on splits of the same samples. Results will be reported to IEPA in a timely manner for this comparison. Blind samples will be analyzed by the laboratory utilizing appropriate analytical methodology and results reported with sample data.

Audits of field activities can be carried out to evaluate sampling activities such as sample identification, sample control, chain-of-custody procedures, field documentation, and general sampling operations.

The Project Manager and QA officer will create a schedule and institute a program for regular system and performance audits.

One field and one laboratory audit will be performed by E & E during the project sampling and analytical activities. The field audit will be performed by an E & E Health and Safety Officer and the laboratory audit by E & E's corporate QA officer. Attachments 1 and 2 provided at the end of Appendix D contain evaluation sheets including a field audit checklist and a laboratory evaluation checklist.

IEPA previously conducted initial performance and system audits during July and August 1985. IEPA will perform a scheduled systems audit during sample analysis for the project.

12. PREVENTIVE MAINTENANCE

All instruments and equipment will be maintained under service agreements with the manufacturers and will be serviced and maintained only by qualified personnel. All repairs, adjustments, and calibrations will be documented in an appropriate logbook or data sheet that will be kept on file.

13. PROCEDURES FOR DATA ASSESSMENT

Performance of the following calculations will be documented and included in the QC section.

13.1 ACCURACY

Accuracy is the difference between an average value and the "true" value when the latter is known or assumed. The term "accuracy" is normally used interchangeably with "percent recovery," and describes either recovery of a known amount of analyte (spike) added to a sample of known value, or recovery of a synthetic standard of known value.

$$\text{Recovery}_{\text{(spike)}} = 100 \times \frac{\text{(concentration spike + sample) - sample}}{\text{concentration spike}}$$

$$\text{Recovery}_{\text{(standard)}} = 100 \times \frac{\text{observed value}}{\text{true value}}$$

<u>Average</u>

The average (or arithmetic mean) of a set of "n" values is the sum of the values divided by "n":

$$X = \frac{\sum^{n} X_1}{n}$$

13.2 PRECISION

Relative to the data from a single test procedure, precision is the degree of mutual agreement among individual measurements made under prescribed conditions. An estimate of standard deviation is normally used to describe the precision of a method.

Standard Deviation Estimate

Standard deviation estimate is the most widely used measure to describe the dispersion of a set of data. Normally, $X \pm S$ will include 68%, and $X \pm 2S$ will include about 95%, of the data from a study.

$$S = \sqrt{\frac{\sum_{i=1} (X_i - \overline{X})^2}{n-1}}$$

Relative Standard Deviation

The estimate of precision of a series of replicate measurements will usually be expressed as the relative standard deviation, RSD:

$$RSD = \frac{SD}{\overline{X}} \times 100\%$$

Percent Relative Difference

A measure of the difference between two samples assumed to be identical through dividing (splitting) an original sample, analyzing each portion, identifying the values of the first replicate (X_1) and that of the second replicate (X_2), and dividing the difference by the mean (X) of x_1 and x_2.

$$RD_{\text{(percent)}} = 100 \frac{x_1 - x_2}{\overline{X}}$$

13.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total amount that was expected to be obtained under normal conditions. A 95% completeness figure is usually required for a particular analysis and overall project objective.

14. CORRECTIVE ACTION

Corrective actions can be initiated as a result of performance and system audits, laboratory and interfield comparison studies, specific problems, and/or a QA program audit, to name a few.

Corrective actions may include altering procedures in the field, conducting subsequent audits, or modifying laboratory protocol. Time and type of corrective action, if needed, will depend on the severity of the problem and relative overall project importance. The project manager is responsible for initiating corrective action and the ASC manager/director or the team leader for its implementation.

Precision and accuracy will be regularly tracked by the analytical staff to determine unacceptable results and to evaluate and implement corrective actions. Corrective actions may include but not be limited to recalibration of instruments using freshly prepared calibration standards; replacement of lots of solvent or other reagents that give unacceptable blank values; additional training of laboratory personnel; or reassignment, if necessary. Corrective actions in many cases may need to be defined as the need arises.

If substantial corrective action is required or if serious QA problems are encountered, the IEPA will be notified by phone and in writing as soon as possible. All corrective action will be implemented and documented after notification and approval of IEPA.

15. QUALITY ASSURANCE REPORTS

For the project sampling effort, no separate QA report will be issued. Analytical and QC data will be included in the comprehensive report summarizing data quality information for the entire project.

Reports will include where appropriate, periodic assessments of accuracy, precision and completeness, results of performance and system audits, and significant QA/QC problems and recommended solutions.

Bimonthly reports will be issued summarizing QA/QC activity as well as problems/comments associated with the analytical and sampling effort. Results from split/duplicate samples will be provided to IEPA in a timely manner for comparison of results. Serious analytical problems will be reported to IEPA by phone and in writing as soon as possible.

Attachment 1

FIELD AUDIT CHECKLIST

Ecology and Environment, Inc.

FIELD AUDIT CHECKLIST

Briefing with On-Site Project Manager (SPM)

PROJECT NO. ____________ **DATE OF AUDIT** ____________

PROJECT MANAGER ____________ **SIGNATURE OF AUDITOR** ____________

OFFICE LOCATION ____________

Yes __ **No** __ **N/A** __ 1. **Was a QA Project Plan and a Site Health and Safety Plan plan prepared? If yes, what items are addressed in the plan?**

Comments: ____________

Yes __ No __ N/A __ 2. Was a briefing held with project participants?

Comments: ____________

Yes __ No __ N/A __ 3. Were additional instructions given to project participants (i.e., changes in project plan)?

Comments: ____________

Yes __ No __ N/A __ 4. Is there a written list of sampling locations and descriptions?

Comments: ____________

Yes __ No __ N/A __ 5. Is there a map of sampling locations?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 6. Does the sampling team follow a system of accountable documents?

If yes, what documents are accountable?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Is there a list of accountable field documents checked out to the SPM or designated person?

If yes, who checked them out?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Is the transfer of field documents (Sample I.D. Tags, Chain-of-Custody Records, logbooks, etc.) from the SPM to the field participants documented in a logbook?

Comments: ______________________________

____

____

FIELD AUDIT CHECKLIST

Field Observations

PROJECT NO. ____________ DATE OF AUDIT ____________

PROJECT MANAGER ____________ SIGNATURE OF AUDITOR ____________

OFFICE LOCATION ____________

Yes __ No __ N/A __ 1. Was permission granted to enter and inspect the facility/sampling site?

Comments: ____________

Yes __ No __ N/A __ 2. Is permission to enter the facility documented?

Comments: ____________

Yes __ No __ N/A __ 3. Were split samples offered to the facility/client? If yes, was the offer accepted or declined?

Comments: ____________

Yes __ No __ N/A __ 4. If the offer to split samples was accepted, were the split samples collected?

Comments: ____________

Yes __ No __ N/A __ 5. Is the offering of split samples recorded?

Comments: ____________

Yes __ No __ N/A __ 6. If split samples were collected, are they documented?

If yes, where are they documented?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Are the number, frequency, and types of field measurements and observations taken as specified in the project plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Are field measurements recorded (pH, temperature, conductivity, etc.)? Where?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 9. Are samples collected in the types of containers specified in the project plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 10. Are samples preserved as specified in the Project Plan or as directed by the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 11. Are the number, frequency, and types of samples collected as specified in the Project Plan or as directed by the SPM?

Comments: ______________________________________

____

____

Yes __ No __ N/A __ 12. Are samples packed for preservation as specified in the Project Plan (i.e., packed in ice, etc.)?

Comments: ______________________________________

____

____

Yes __ No __ N/A __ 13. Is sample custody maintained at all times?

Comments: ______________________________________

____

____

FIELD AUDIT CHECKLIST

Document Control

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT MANAGER ____________________ SIGNATURE OF AUDITOR ____________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Have all unused and voided accountable documents been returned to the SPM by the team members?

Comments: ____

____

____

Yes __ No __ N/A __ 2. Have document numbers of all lost or destroyed accountable documents been recorded in the SPM's logbook?

Comments: ____

____

____

Yes __ No __ N/A __ 3. Are all samples identified with Sample I.D. Tags?

Comments: ____

____

____

Yes __ No __ N/A __ 4. Are all Sample I.D. Tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)?

Comments: ____

____

____

Yes ___ No ___ N/A ___ 5. Are all samples collected listed on a Chain-of-Custody Record?

If yes, describe the type of Chain-of-Custody Record used.

Comments: ____

____

____

Yes ___ No ___ N/A ___ 6. Are the Sample I.D. Tag numbers recorded on the Chain-of-Custody Records?

Comments: ____

____

____

Yes ___ No ___ N/A ___ 7. Does information on Sample I.D. Tags and Chain-of-Custody Records match?

Comments: ____

____

____

Yes ___ No ___ N/A ___ 8. Do the Chain-of-Custody Records indicate the method of sample shipment?

Comments: ____

____

____

Yes ___ No ___ N/A ___ 9. Is a Chain-of-Custody record included with the samples in the shipping container?

Comments: ____

____

____

Yes __ No __ N/A __ 10. Do the sample traffic reports agree with the Sample I.D. Tags?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 11. If required, has a copy of a Receipt-For-Samples form been provided to the facility?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 12. If required, was the offer of a receipt for samples documented?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 13. If used, are blank samples identified?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 14. If collected, are duplicate samples identified on Sample I.D. Tags and Chain-of-Custody Records?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 15. If used, are spiked samples identified?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 16. Are Field Notebooks signed by the individual who checked out the notebook from the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 17. Are Field Notebooks dated upon receipt from the SPM?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 18. Are Field Notebooks project-specific (by notebook or by page)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 19. Are Field Notebook entries dated and identified by author?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 20. Is the facility's approval or disapproval to take photographs noted in a Field Notebook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 21. Are photographs documented in Field Notebooks (e.g., time, date, description of subject, photographer, etc.)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 22. If a Polaroid camera is used, are photos matched with Field Notebook documentation?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 23. Are Sample I.D. Tag numbers recorded in the SPM logbook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 24. Are Quality Control checks documented (i.e., calibration of pH meters, conductivity meters, etc.)?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 25. Are amendments to the Project Plan documented (on the Project Plan itself, in a project logbook, elsewhere)?

Comments: ______________________________

____

____

FIELD AUDIT CHECKLIST

Debriefing with SPM or Field Sampling Team Leader

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT MANAGER ____________________ SIGNATURE OF AUDITOR ____________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Was a debriefing held with project participants after the audit was completed?

Comments: ____________________

____

____

Yes __ No __ N/A __ 2. Were any recommendations made to project participants during the debriefing?

If yes, briefly describe what recommendations were made.

Comments: ____________________

____

____

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____

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____

____

DOCUMENT AUDIT CHECKLIST

Closed Files

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT LOCATION ________________ SIGNATURE OF AUDITOR ________________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Have individual files been assembled (field investigation, laboratory, other)?

Comments: ____________________________________

Yes __ No __ N/A __ 2. Is each file inventoried?

Comments: ____________________________________

Yes __ No __ N/A __ 3. Is a document numbering sytem used?

Comments: ____________________________________

Yes __ No __ N/A __ 4. Has each document been assigned a document control number?

Comments: ____________________________________

Yes __ No __ N/A __ 5. Are all documents listed on the inventory accounted for?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 6. Are there any documents in the file that are not on the inventory?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. Is the file stored in a secure area?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Are there any project documents that have been declared enforcement sensitive?

Comments: ______________________________

____

____

DOCUMENT AUDIT CHECKLIST

Enforcement Sensitive Documents

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT LOCATION ______________ SIGNATURE OF AUDITOR ______________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Are Enforcement Sensitive documents stored in a secure area separate from other project documents?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 2. Are Enforcement Sensitive documents listed in the project file?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 3. Is access to Enforcement Sensitive files restricted?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 4. Have classified documents been marked or stamped "Enforcement Sensitive?"

Comments: ________________________________

____

____

Yes __ No __ N/A __ 5. Is classified information inventoried?

Comments: ________________________________

____

____

Yes __ No __ N/A __ 6. Is classified information numbered for document control?

Comments: ______________________________

____

____

DOCUMENT AUDIT CHECKLIST

Active Project Files

PROJECT NO. ____________________ DATE OF AUDIT ____________________

PROJECT LOCATION ______________ SIGNATURE OF AUDITOR ______________

OFFICE LOCATION ____

Yes __ No __ N/A __ 1. Are project notebooks being maintained in accordance with E & E policies?

Comments: ____________________________________

Yes __ No __ N/A __ 2. Are project activities logbooks being kept up to date?

Comments: ____________________________________

Yes __ No __ N/A __ 3. Is each entry in the project activities logbook identified by date and author, if made by persons not originally assigned to the book?

Comments: ____________________________________

Yes __ No __ N/A __ 4. Are entries legible, factual, and made in ink?

Comments: ____________________________________

Yes __ No __ N/A __ 5. **Are modifications to the project workplan noted in the project activities logbook or elsewhere?**

Comments: ______________________________

____

____

Yes __ No __ N/A __ 6. Is an inventory of serialized field documents (Sample I.D. Tags, Chain-of-Custody Records, etc.) in the document control inventory logbook?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 7. **Does the Field Notebook contain adequate information about each sample including the Sample I.D. Tag number, date, location, and information necessary to reconstruct the sample?**

Comments: ______________________________

____

____

Yes __ No __ N/A __ 8. Are entries to the Field Notebook made in ink?

Comments: ______________________________

____

____

Yes __ No __ N/A __ 9. **Are corrections properly executed with one line through the error in all project logbooks and Field Notebooks?**

Comments: ______________________________

____

____

Yes __ **No** __ **N/A** __ 10. Are all project notebooks and logbooks properly labeled with the project number, site number/ designation, and title?

Comments: ______________________________

____

____

DOCUMENT AUDIT CHECKLIST

Document Control Officer

OFFICE LOCATION ______________________________

DATE OF AUDIT ______________________________

SIGNATURE OF AUDITOR ______________________________

Yes __ **No** __ **N/A** __ 1. Is an inventory of serialized field documents (Sample I.D. Tags, Chain-of-Custody Records, Receipt-for-Samples Form, etc.) in the document control inventory logbook?

Comments: ______________________________

____

____

Yes __ **No** __ **N/A** __ 2. **Are project materials secured during other than working hours unless they are in use?**

Comments: ______________________________

____

____

Yes __ **No** __ **N/A** __ 3. **Is Enforcement Sensitive material maintained in a secured area with a check-out log at all times?**

Comments: ______________________________

____

____

Attachment 2

LABORATORY EVALUATION CHECKLIST

Ecology and Environment, Inc., (E & E)

Laboratory Evaluation Checksheet

Laboratory: ____________________

Address ____________________

Date ____________________

Contract Number: ____________________

Contract Title: ____________________

Personnel Contacted:

Name	**Title**

Laboratory Evaluation Team:

Name	**Title**

ORGANIZATION AND PERSONNEL

ITEM	Yes/No/NA	Comments
Laboratory or Project Manager (individual responsible for overall technical effort): Name: ______________		
Plasma Emission Spectroscopist Name ______________ Experience: 1 year minimum requirement		
Flameless Atomic Absorption Spectroscopist Name ______________ Experience: 1 year minimum requirement		
Inorganic Sample Preparation Expert Name ______________ Experience: 1 year minimum requirement		
Flame and Cold Vapor AA Spectroscopist Name: ______________ Experience: 1 year minimum requirement		
Classical Inorganic Techniques Analyst: Name: ______________ Experience: 1 year minimum requirement		

Requirements for experience as listed are minimal and may be increased for specific projects involving difficult samples or unusual matrices.

ITEM	Yes/No/NA	Comments
GC/MS Operator: Name: ______________________________ Experience: 1 year minimum requirement		
GC/MS Spectral Interpretation Expert: Name: ______________________________ Experience: 3 years minimum requirement		
Purge and Trap Expert: Name: ______________________________ Experience: 1 year minimum requirement		
Extraction Concentration Expert: Name: ______________________________ Experience: 1 year minimum requirement		
Gas chromatography and/or Pesticide Residue Analysis Expert: Name: ______________________________ Experience: 2 years minimum requirement		
Do the personnel assigned to this project have appropriate educational background to successfully accomplish the objectives of this project?		

ITEM	Yes/No/NA	Comments
Do personnel assigned to this project have the appropriate level and type of experience to successfully accomplish the objectives of this program?		
Is the organization adequately staffed to meet project commitments in a timely manner?		
Does the laboratory Quality Assurance supervisor report to senior management levels?		
Was the Project Manager available during the evaluation?		
Was the Quality Assurance supervisor available during the evaluation?		
Does the laboratory have a Quality Assurance Officer?		

Sampling

ITEM	Yes/No/NA	Comments
Do sampling procedures follow contract specifications?		
Is a unique identification on each sample?		
Is sampling information properly recorded such as sample type, sampling location, date and time of collection and name of sample collector?		
Are written chain-of-custody procedures available for review? Are they in accordance with E & E/EPA guidelines?		
Are tamper-proof seals used on samples that are shipped?		
Are Department of Transportation regulations in effect for samples that are shipped?		
Are proper sample containers being used as specified in E & E sample handling protocol?		
Are proper preservation techniques being used for the analytical methods and sample types concerned?		
Are provisions made for the collection of QA split samples?		
Are provisions made for field blanks and duplicate samples at an appropriate percentage (normally 10% each minimum or 1 each per set, whichever is greater, or as specified in contract?		
Is waste to be bulked prior to off-site disposal?		
Are adequate facilities available to do compatibility testing?		

GENERAL FACILITIES-Sample Receipt, Storage, and Preparation Areas

When touring the facilities, give special attention to: (a) the overall appearance of organization and neatness, (b) the proper maintenance of facilities and instrumentation, (c) the general adequacy of the facilities to accomplish the work.

ITEM	Yes/No/NA	Comments
Is a sample custodian designated for chain-of-custody samples? If yes, name of sample custodian. Name: ______________________		
Are written Standard Operating Procedures (SOP's) developed for receipt and storage of samples? Is a permanent logbook maintained with all pertinent sample information?		
Is the appropriate portion of the SOP available to the analyst at the sample receipt/storage area?		
Are chain-of-custody seals checked for integrity?		
Are the sample shipping containers opened in a manner to avoid possible laboratory contamination?		
Are samples that require preservation stored in such a way as to maintain their preservation?		
Are volatile samples stored separately from semi-volatile samples?		
Are adequate facilities provided for storage of samples, including cold storage?		
Is a system in effect which assures that the cold storage temperature is maintained?		
Are temperature excursions noted and are appropriate actions taken when required?		

ITEM	Yes/No/NA	Comments
Is the laboratory maintained in a clean and organized manner?		
Does the laboratory appear to have adequate work-space (120 sq feet, 6 linear feet of unencumbered bench space per analyst)?		
Are special facilities provided for handling extremely toxic materials such as dioxin (e.g., glove box, controlled air)?		
Are contamination-free work areas provided for trace level analytical work?		
Are exhaust hoods provided to allow contamination-free work with volatile and hazardous materials?		
Is the air flow of the hoods periodically checked and recorded?		
Are chemical waste disposal policies/procedures well-defined and followed by the laboratory?		
Is de-ionized water available for preparation of standards and blanks (both for Inorganics and Organics)?		
Are periodic safety briefings or lectures given?		
Are periodic QA/QC or general meetings held at regular intervals?		
Does the laboratory have adequate safety devices (eye wash stations, spill control stations, showers, first-aid stations, etc.)		
Are proper glassware cleaning procedures appropriate to analyses followed?		

ITEM	Yes/No/NA	Comments
Is the analytical balance located away from draft and areas subject to rapid temperature change?		
Has the balance been calibrated and checked within one year by a certified technician?		
Is the balance routinely checked with appropriate class S weights before each use and are the results recorded in a logbook?		
Is adequate chemical storage space available and are chemicals properly segregated according to class?		
Are solvent storage cabinets properly vented as appropriate for the prevention of possible laboratory contamination?		
Are reagent grade or higher purity chemicals used to prepare standards?		
Are analytical reagents dated upon receipt?		
Are reagent inventories maintained on a first-in, first-out basis?		
Are analytical reagents checked out before use?		
Are fresh analytical standards prepared at a frequency consistent with procedure requirements?		
Are reference materials properly labeled with concentrations, date of preparation, and the identity of the person preparing the sample?		

INSTRUMENTATION

List the major laboratory instruments that will be used. Complete and instrument evaluation form on each one. (Note manufacturer, model, year of purchase, detectors, columns or other accessories should be listed.)

Instrument	Analysis

ITEM	Yes/No/NA	Comments
Is a logbook maintained to keep track of the preparation of spiking/calibration standards?		
Are the primary standards traceable to NBS or EPA standards?		
Do the analysts record bench data in a neat and accurate manner?		
Does the supervisor periodically examine and review the logbooks, notebooks and bench sheets?		
Are standards stored separately from sample extracts?		
Are volatile and semi-volatile solutions properly segregated?		
Is the appropriate portion of the SOP or procedures manual available to the analyst at the sample preparation area?		
Is the SOP for glassware washing posted at the cleaning station?		

Instrument Evaluation Form

Instrument: ______________________

Instrument Mfg. ______________________________________

Model: ____________________ Year of Acquisition: ______

Condition: ______________________________________

Calibration Frequency: ________________________________

Service Maintenance Frequency: ___________________________

Other Pertinent Information: _____________________________

ITEM	YES	NO	COMMENT
Are manufacturer's operating manuals readily available to the operator?			
Is there a calibration protocol available to the operator?			
Are calibration results kept in a permanent record? (permanent log book listing calibrations, instrument problems, etc. should be kept by each instrument.)			
Is a permanent service record maintained?			
Has the instrument been modified in any way?			
Is the instrument properly vented?			
SATISFACTORY?	☐	☐	

Comments: ____

Analytical Methodology

ANALYTE	REFERENCE	SPECIFIED IN CONTRACT YES	NO

ITEM	Yes/No/NA	Comments
Are the required methods used?		
Is there any unauthorized deviation from contract methodology?		
Are written analytical procedures provided to the analyst?		
Are reagent grade or higher purity chemicals used to prepare standards?		
Are fresh analytical standards prepared at a frequency consistent with good QA?		
Are reference materials properly labeled with concentrations, date of preparation, and the identity of the person preparing the sample?		
Is a standards preparation and tracking logbook maintained?		
Do the analysts record bench data in a neat and accurate manner?		
Is the appropriate instrumentation used in accordance with the required protocol(s)?		

Quality Control

ITEM	Yes/No/NA	Comments
Does the laboratory maintain a Quality Control Manual?		
Does the manual address the important elements of a QC program, including the following:		
a. Personnel?		
b. Facilities and equipment?		
c. Operation of instruments?		
d. Documentation of procedures?		
e. Procurement and inventory practices?		
f. Preventive maintenance?		
g. Reliability of data?		
h. Data validation?		
i. Feedback and corrective action?		
j. Instrument calibration?		
k. Recordkeeping?		
l. Internal audits?		
Is the Site-Specific Quality Assurance Project Plan (QAPP) (the technical portions of which should be included with the contract provisions) available to laboratory personnel?		
Are laboratory personnel familiar with the QC requirements of the QAPP?		

ITEM	Yes/No/NA	Comments
Are QC responsibilities and reporting relationships clearly defined?		
Have standard curves been adequately documented?		
Are laboratory standards traceable?		
Are quality control charts maintained for each routine analysis?		
Do QC records show corrective action when analytical results fail to meet QC criteria?		
Do supervisory personnel review the data and QC results? How promptly?		
Are data calculations checked by a second person?		
Are data calculations documented?		
Are recoveries of organic surrogates documented?		
Are limits of detection determined and reported properly?		
Are all data and records retained for the required amount of time?		
Are quality control data (e.g., standard curve, results of duplication and spikes) accessible for all analytical results?		
Do supervisory personnel understand and agree to the reporting requirements required by the Contract and the Site-Specific QAPP?		
Are outside standard QC samples (such as EPA samples) run at least twice a year on each routinely performed method to verify that the standards used, the method used, and the instrument used is within acceptable limits?		

Analysis Time Frame

ITEM	Yes/No/NA	Comments
Is the Laboratory familiar with the required time frame for reporting data?		
Are personnel familiar with holding times of various analysis parameters?		
Does laboratory have sufficient personnel and instrumentation to meet time requirements?		
Does laboratory have a written policy of what to do in case of instrument breakdown (such as backup instrumentation, etc.)?		

Reporting Procedures

ITEM	Yes/No/NA	Comments
Is a standard reporting format required?		
Will interim sampling and analysis results be reported to the client for review and comment?		
Is provision made for a project QA report to summarize all QC data?		
Is provision made for the submission of raw data and chromatograms if required?		

APPENDIX E

COMMUNITY RELATIONS PLAN

Date: 11/19/85 Coordinator: Keri Luly

COMMUNITY RELATIONS PLAN
for
SAUGET SITES

1. BACKGROUND

1.1 Site Name:

Sauget Sites (formerly Dead Creek)

1.2 Location:

Sauget & Cahokia industrial area (St. Clair Co.)

1.3 Owner/Operator:

Not specifically identified

1.4 Description of the Site (including type of operation--landfill; manufacturing, dumping, reclamation; years of operation; number and location of on-site buildings; and surface waters on or near the site):

Numerous old dump sites scattered about the Sauget area, including Dead Creek. Sites connected by groundwater (American Bottoms)

2. CONTAMINATION

2.1 Type(s) of waste:

White phosphorus, PCBs, dioxin, heavy metals and organics

Concentrations varied, will be quantified in RI. Contaminants likely to be found in soils, groundwater, buried drums and some surface water.

2.2 Surface Water Contamination?

Very likely in the creek bed (Dead Creek) and possible in Cahokia Chute.

2.3 Groundwater Contamination:

Very probable for entire area.

2.4 Are private drinking water wells in the vicinity?

They are no longer used for drinking water. Well water may be used to water lawns.

2.5 Air emissions? If yes, do they pose a health threat or nuisance?

Possible emissions. During the sampling and/or removal process, drilling wells or moving materials on-site could possibly allow the release of pollutants into the air.

3. KEY ISSUES

3.1 Concerns and issues identified by local officials and citizens:

3.1.1 Primary concern is that not enough action has been taken, things are moving too slowly.

3.1.2 Concern about kids playing in creek bed was alleviated by fencing.

3.1.3 Well water harmful to gardens, shrubbery and flowers.

3.2 Brief evaluation of the level of citizen concern:

Citizens living near the creek have expressed concern, but are satisfied that IEPA is finally addressing the problem. Continuation of flow of information is vital to maintain trust.

3.3 Health effects (Note long- and short-term effects and correlate to concentrations when possible):

It is doubtful that a health study has been done in the area but possible that IDPH may undertake one.

4. COMMUNITY RELATIONS OBJECTIVES FOR THIS SITE:

4.1 Seek information from the long-time residents regarding the dumping that has occurred for over 50 years.

4.2 Keep mayors and citizens informed of progress at sites.

5. CONTACT LIST

5.1 Elected Officials:

5.1.1 Mayor: Cahokia -- Michael King 618/337-7182 Sauget -- Paul Sauget 618/337-5267

5.1.2 County Board Chairperson: Jerry Costello

5.1.3 County & local health officials:
local -- Tonie Townsend
618/337-3898
county -- office to be established

5.1.4 State & federal elected representatives:

Honorable Monroe L. Flinn
Illinois State Representative
20th & State St.
Granite City, Illinois 62040

Honorable Wyvetter H. Younge
Illinois State Representative
2000 State St.
E. St. Louis, Illinois 62205

Honorable Kenneth Hall
Illinois State Senator
327 Missouri St., Room 427
E. St. Louis, Illinois 62201

5.2 News Media:

5.2.1 Radio:

WESL -- 618/271-1490
KMOX -- 314/521-2345

5.2.2 Newspapers (daily & weekly):

Cahokia Journal -- 618/332-6000
Globe Democrat -- Jim Orso -- 314/342-1212
Post Dispatch -- Marjorie Mandel -- 314/622-7000
Cahokia-Dupo Herald -- Mike Leathers -- 337/7300
Belleville News-Democrat -- Pat Cox -- 800/642-3878, x 460

5.2.3 Television:

St. Louis Stations:

KMOX (4) -- 314/621-2345
KTVI (2) -- 314/647-2222
KSDK (5) -- 314/421-5055
KPLR (11) -- 314/367-7216

5.3 Adjacent Property Owners:

Kathy & Steve Beck--Judith Lane, Cahokia 62206 -- 618/337-1436
Walter Allen--101 Walnut, Cahokia -- 618/332-6533

Andrew Hankins--3108 Mississippi, Sauget 62201 -- 618/337-5026
Nancy Batson--102 Walnut, Cahokia -- 618/337-4089
Janet & Robert Wright--100 Judith Lane, Cahokia -- 618/337-1025 (her office 314/621-7755)

Persons and organizations who have expressed an interest or have identified interest and so should be contacted.

(property owners listed above)
Cahokia Chamber of Commerce -- 618/337-3893
Cahokia Board of Education -- 618/332-1333
Village Board members -- Cahokia 618/337-3492 & 618/337-5267

6. WORKPLAN AND LOG

Community relations techniques and dates:

Community Relations Technique	Approximate Date
• Depository	
- update these in village halls of Cahokia and Sauget	As new information is released
• Meeting of IEPA, E & E and local mayors (informal)	December 4, 1985
- will discuss RI/FS and schedule	
• Fact sheet (background, schedule, maps, etc.)	December 1985
- will knock on doors of residents near the creek to personally hand out fact sheets (notification beforehand in local paper)	December 1985
- others will be mailed to local organizations, citizens who have expressed concerns, other local officials and (a supply to) the local village halls.	December 1985
• Telephone contacts with mayors, citizens and media	Winter 85-86
• Site visits (when appropriate)	Winter/Spring 85-86
- due to scattered site locations, a site tour might not be practical. An occasional demonstration of study methods (placing wells, etc.) for citizens might be effective	

• Public meeting (informal) - precede meeting with mailed fact sheet describing activities/progress so far to allow citizens time to formulate questions and comments before meeting - open to media	Spring 86
• Continued telephone contacts, site visits	Spring/Summer/Fall 86
• Public meeting (informal) - update of activities/progress - precede with fact sheet if appropriate - open to media	Winter 86-87
• Formal public hearing to discuss alternatives described in FS - provide written description of the alternatives for distribution to public - press release	Early Summer 87
• Comment Period/Response Summary - public hearing occurs during the comment period - response summary follows the hearing and comment period. Describes comments, questions and concerns of public: IEPA responses and the selected alternative. Summary is made available to interested citizens.	Summer/Fall 87
• Continued telephone contacts	Summer/Fall/Winter 87
• Fact sheet and press release - explain chosen alternative and process of design, construction and monitoring	Fall/Winter 87
• Update citizens as needed during construction	Winter/Spring 87-88
• Wrap-up meeting - describe continued monitoring	End of remedy

Amendments to the community relations plan will be made throughout the course of the RI/FS, design and construction to allow for any unexpected events, schedule changes, industrial involvement, etc.

APPENDIX F

PERMITTING REQUIREMENTS PLAN

No permitting is expected to be required for the RI phase of the project. Plans for obtaining any permits that may subsequently be identified will be developed as needed. Wastes generated during the RI portion will be the responsibility of IEPA.

APPENDIX G

SITE MAPS

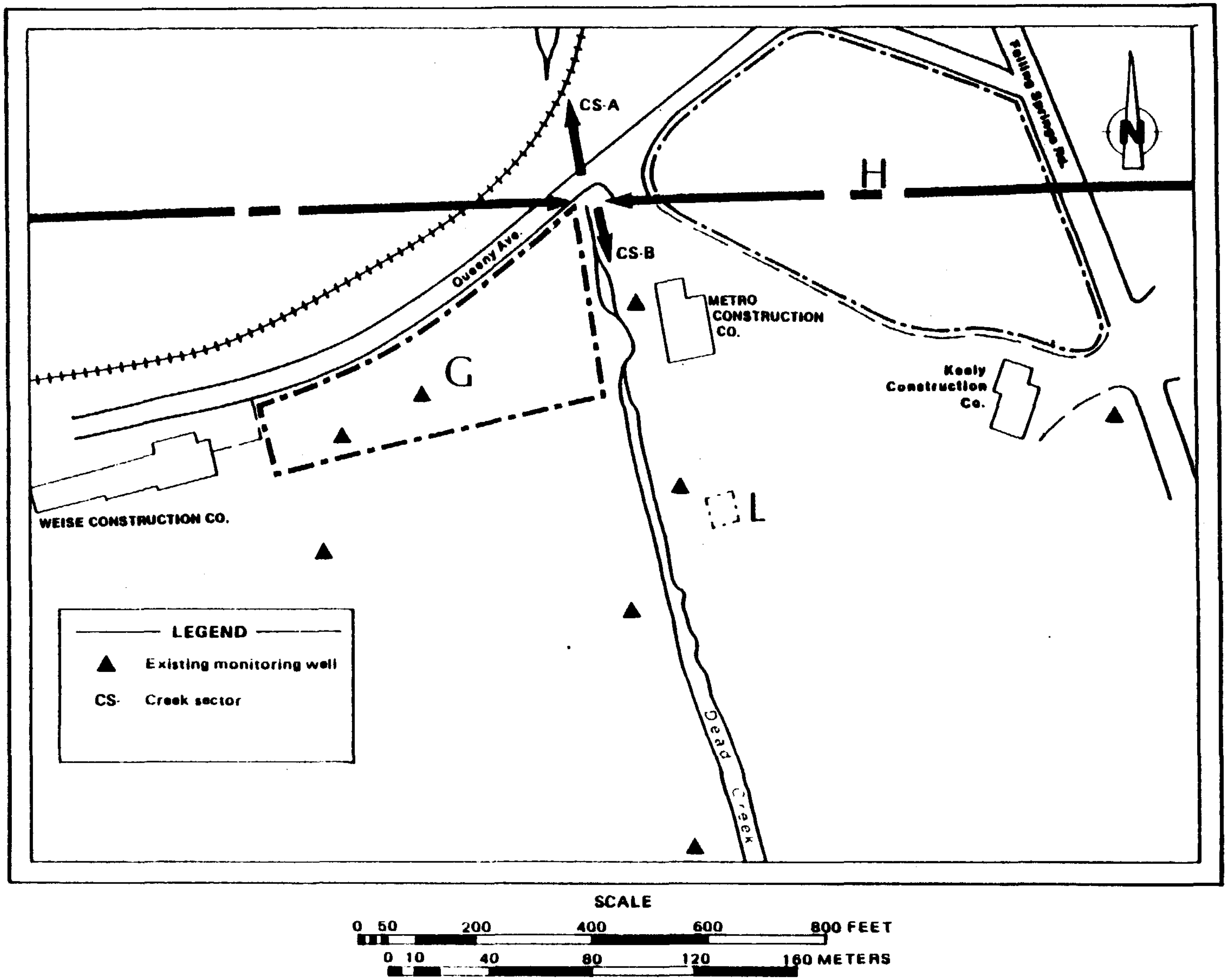


Figure G-1 DEAD CREEK SITE AREAS G, H AND L, AND CREEK SECTORS A AND B

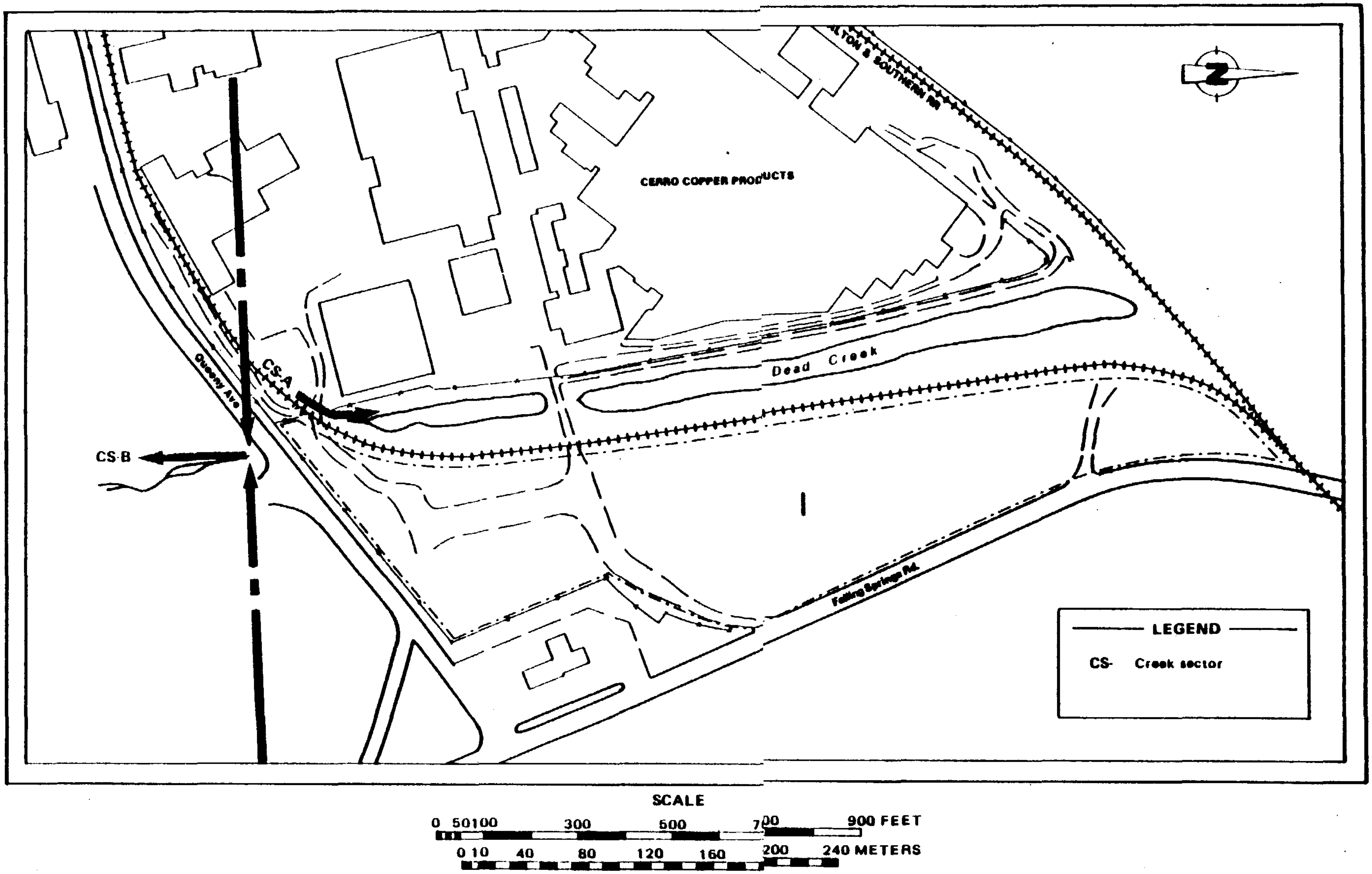


Figure G–2 DEAD CREEK SITE AREA I, AND CREEK SECTORS A AND B

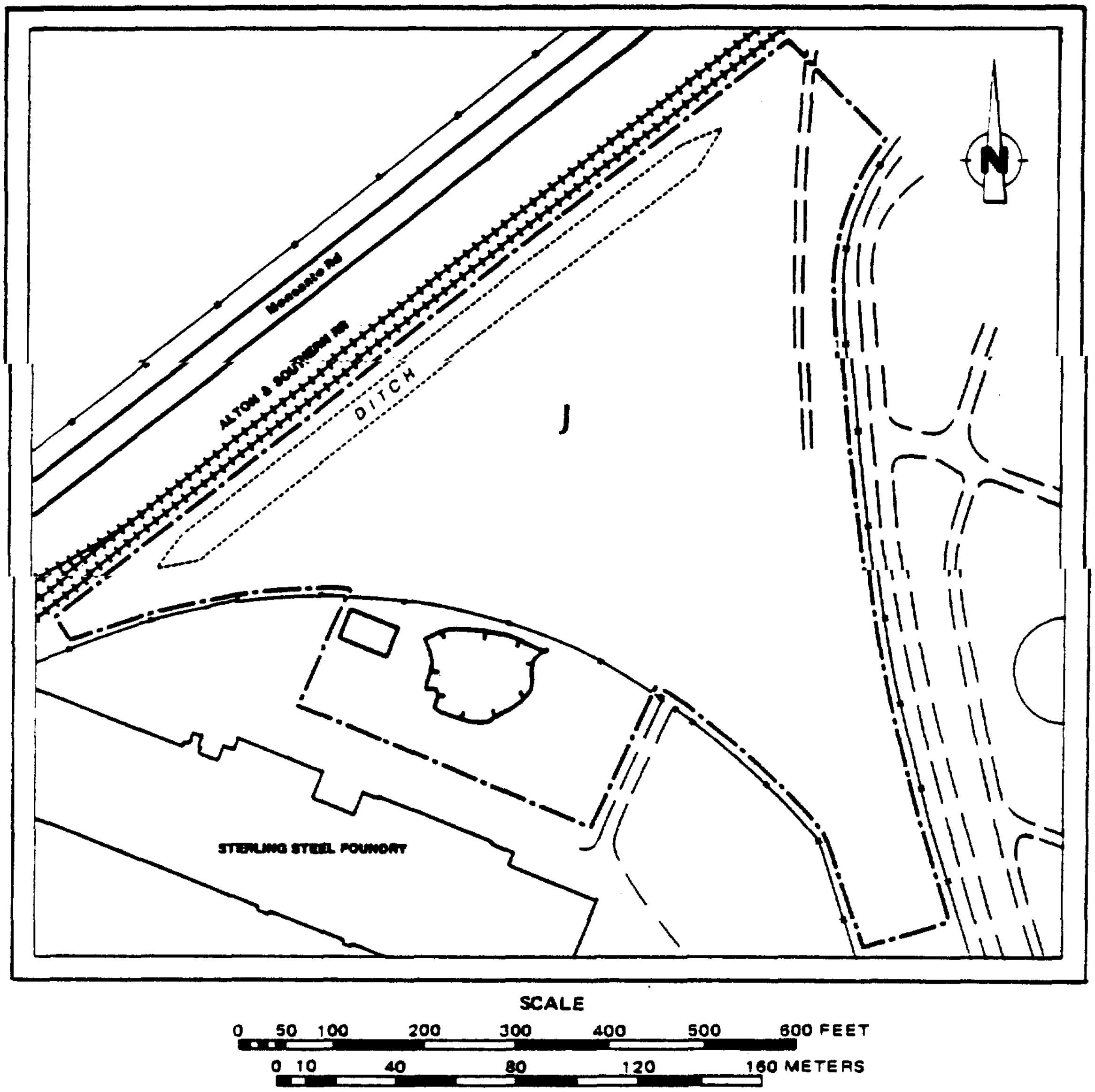


Figure G–3 DEAD CREEK SITE AREA J

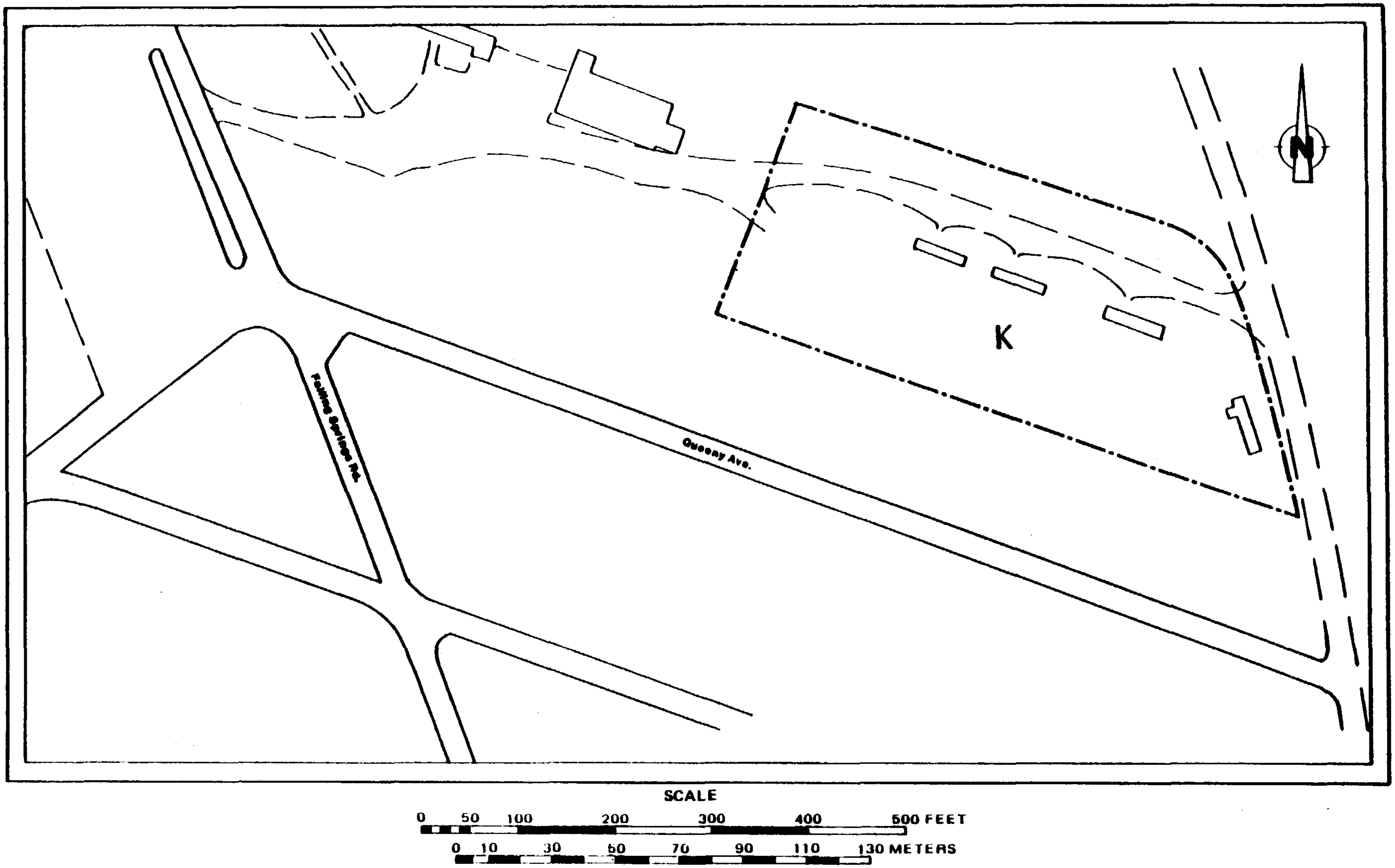


Figure G-4 DEAD CREEK SITE AREA K

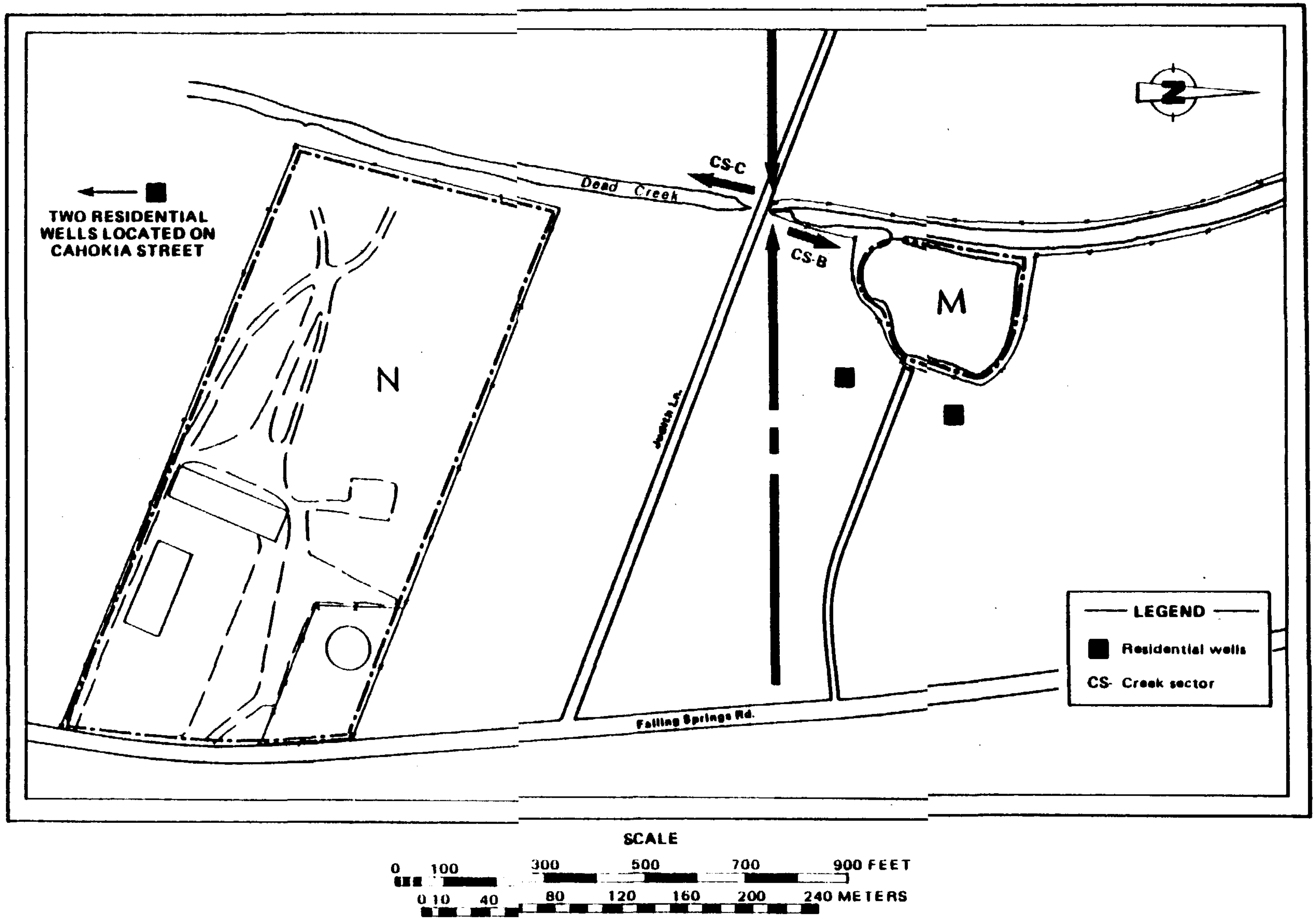


Figure G–5 DEAD CREEK SITE AREAS N AND M, AND CREEK SECTORS B AND C

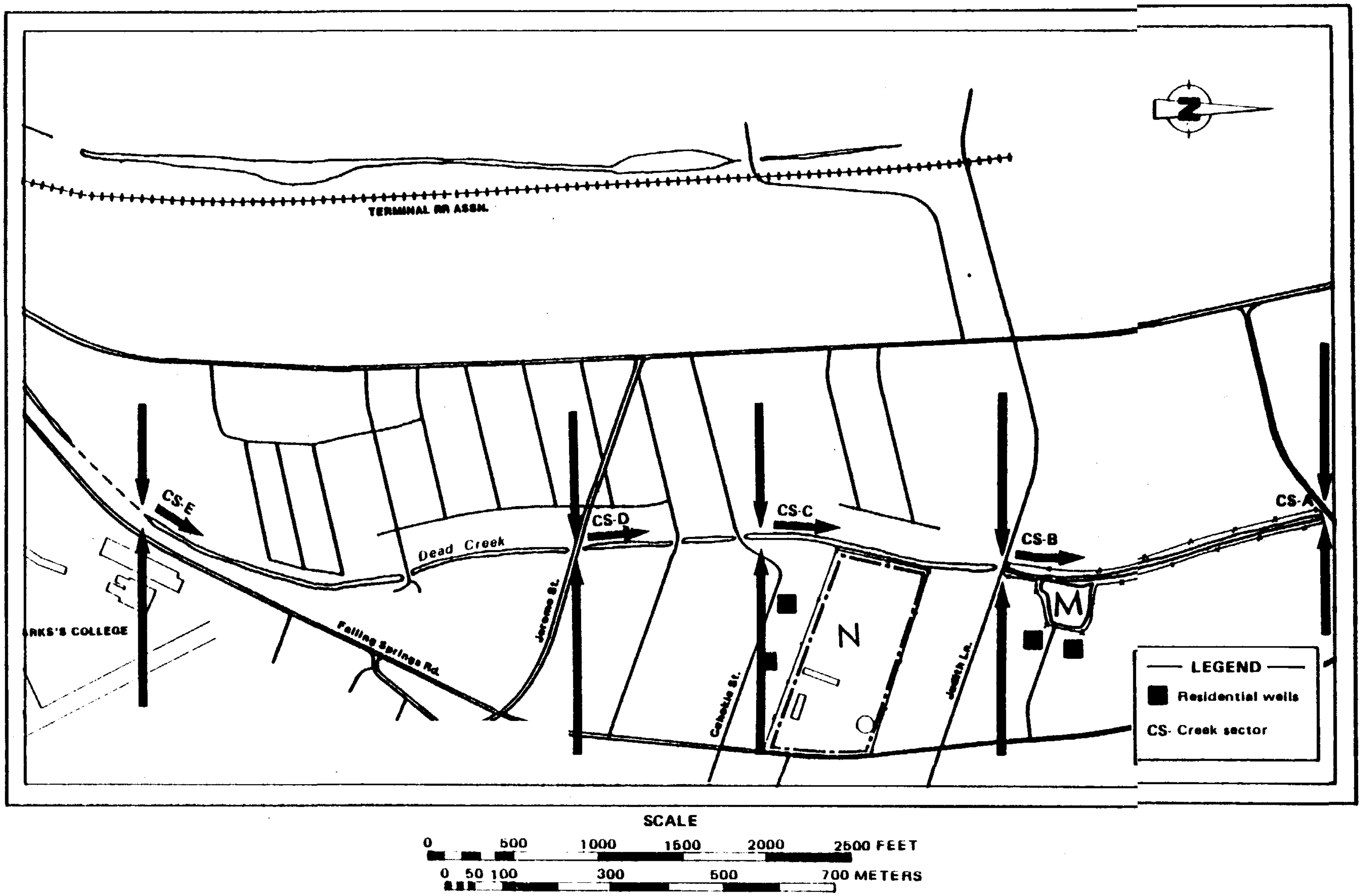


Figure G–6 DEAD CREEK SITE AREAS N AND M, AND CREEK SECTORS A, B, C, D, E, AND F

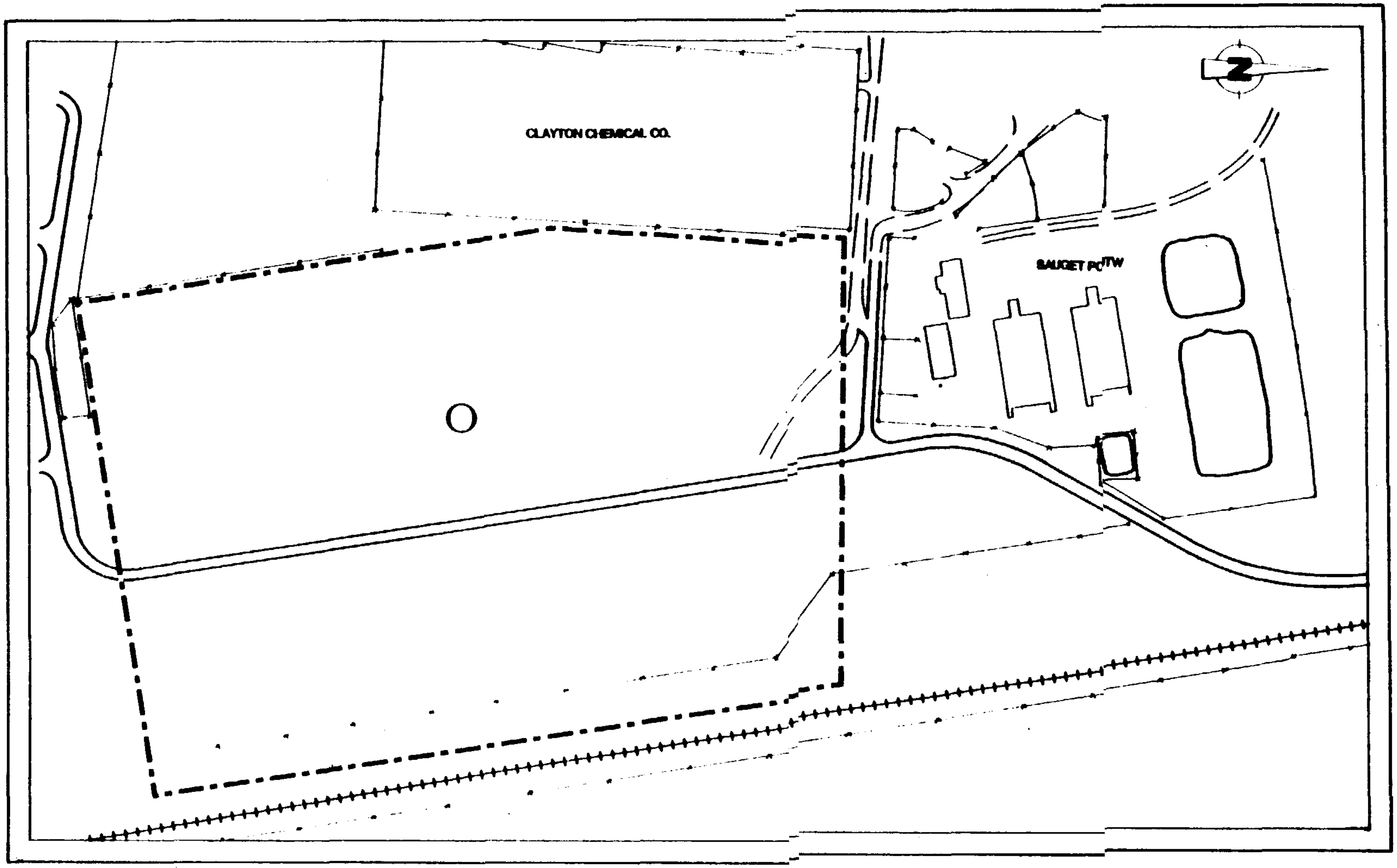
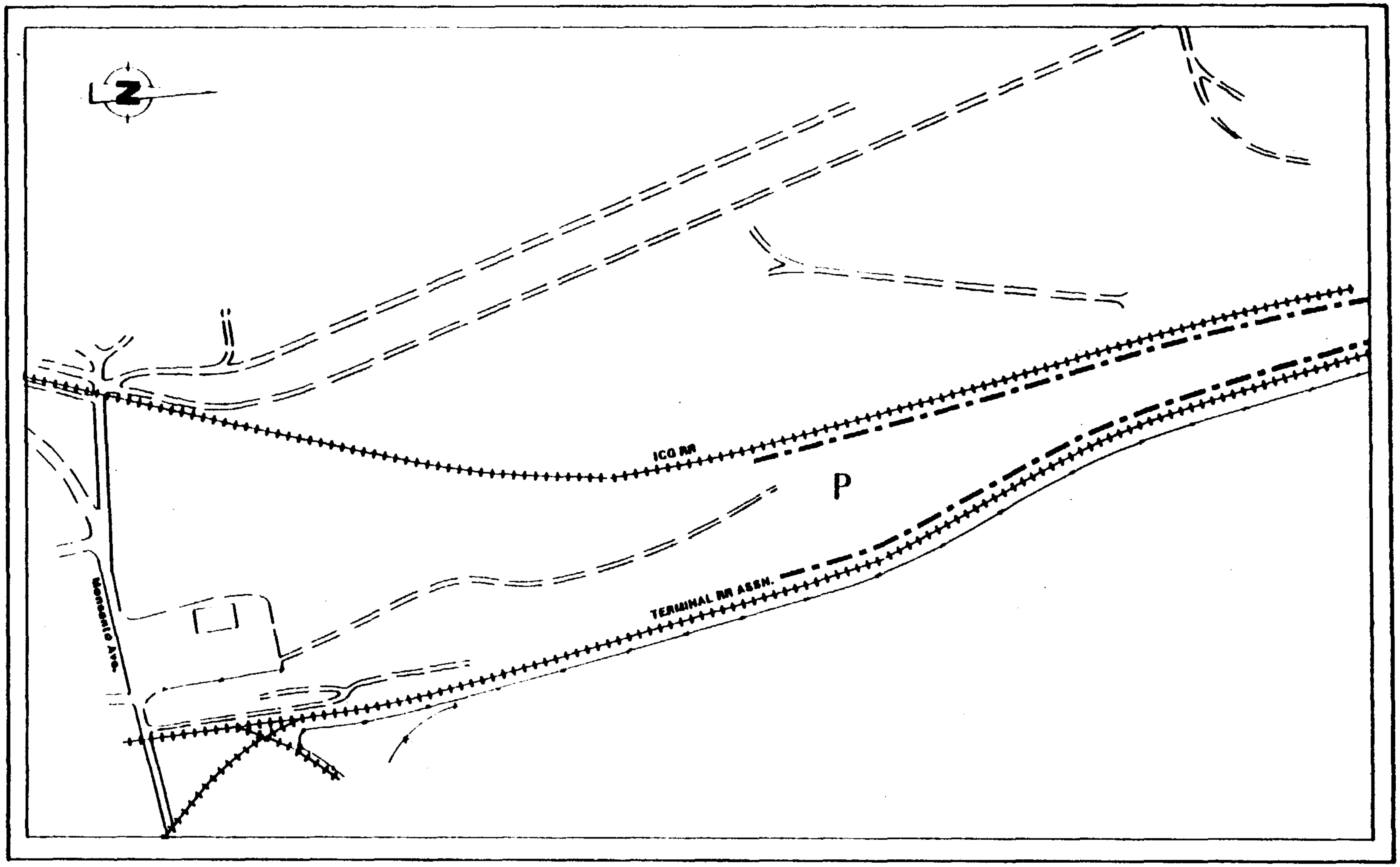


Figure G–7 DEAD CREEK SITE AREA O



SCALE

0 100 200 400 600 800 1000 1200 1400 FEET

0 50 100 200 300 METERS

Figure G–8 DEAD CREEK SITE AREA P

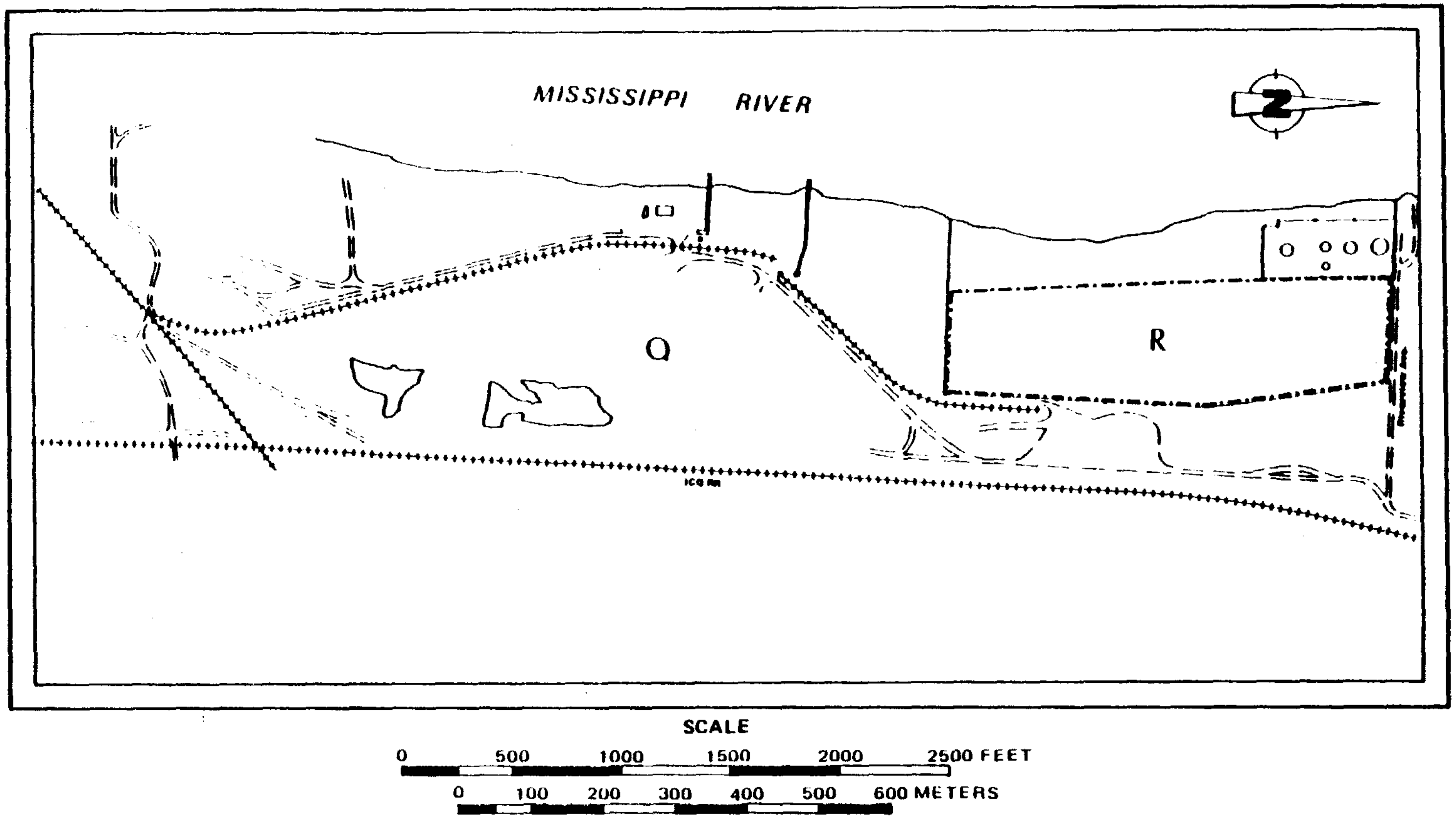


Figure G–9 DEAD CREEK SITE AREAS Q AND R